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COMMERCIAL APPLICATIONS OF SOLAR TOTAL ENERGY SYSTEMS

Final Report, Volume 3, Conceptual Designs and Market Analyses

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CONTENTS

	Page
Foreword	7
1.0 Introduction and Summary.	9
2.0 Evaluation of Solar Total Energy Systems (STES) Concepts.	12
2.1 Optimization of Organic Rankine Cycle STES Operation Conditions	13
2.2 Building Size Effects.	18
2.2.1 Organic Rankine STES.	18
2.2.2 Photovoltaic STES	20
2.3 Parametric Effects	20
2.3.1 Effect of Location on Collector Efficiency.	23
2.3.2 Effect of Escalation Rates and Project Start Year.	23
2.3.3 Sensitivity of Breakeven Cost of Electricity.	27
2.3.4 Financial Parameters.	31
2.4 Concept Evaluation and Sensitivity Analysis Conclusions . . .	34
3.0 Selected Concept Configurations	37
3.1 Photovoltaic STES Configurations	37
3.2 Rankine Cycle Thermal STES Configurations.	75
3.3 Selected Concept Conclusions	113
4.0 Market Analysis	115
4.1 Market Scope and Projections	115
4.2 Market Penetration	119
4.3 Market Analysis Conclusions.	133
5.0 Project Utilization Plan.	137
5.1 Demonstration Project Selection Criteria	139
5.2 User Requirements	141
5.3 Technology Requirements.	143
5.4 Institutional Constraints.	144
5.5 Utility Interface	144
5.6 Work Breakdown Structure (WBS)	147
References	149
List of Symbols.	153

TABLES

	Page
1. Penetrable Commercial Sector	116
2. Nominal Data on Power Costs for a Number of Typical Sites.	121
3. STES Demonstration Site/Application Evaluation Criteria.	140

FIGURES

1. Solar Thermal STES Concept Block Diagram	8
2. Photovoltaic STES Concept Block Diagram.	10
3. Diagram of Solar Thermal STES Concept.	13
4. Effect of Heating Load to Electrical Load Ratio on Cascading PCS Thermal Energy	14
5. Effect of Cost of Electrical Energy to Thermal Energy Ratio on Cascading PCS Thermal Energy.	15
6. Comparison of Turbine Inlet Temperature Effects on Cascaded STES in Blue Hill, MA	17
7. Effect of Energy Usage on Breakeven Cost of Electricity in Blue Hill, MA	18
8. Effect of Installed STES Size on Breakeven Cost of Electricity (Rankine STES)	19
9. Diagram of Photovoltaic STES Concept	21
10. Effect of Installed STES Size on Breakeven Cost of Electricity (Photovoltaic STES).	22
11. Effect of Location on Collector Efficiency	24
12. Large Shopping Center (70,755 m ²) Effect of Location on Electricity Breakeven Cost	25
13. Effect of Escalation Rates and Project Start Year on Breakeven Electricity Costs for a Large Shopping Center (70,755 m ²), Blue Hill, MA	26
14. Effect of Collector Cost on Breakeven Electricity Cost for a Large Shopping Center (70,755 m ²), Blue Hill, MA	28
15. Effect of Battery Costs on Breakeven Electricity Costs (Photovoltaic STES) for a Large Shopping Center (70,555 m ²), Blue Hill, MA.	29
16. Effect of Operations and Maintenance Costs on Breakeven Electricity Costs for a Large Shopping Center (70,555 m ²), Blue Hill, MA.	30

FIGURES

	Page
17. Effect of STES Size on Breakeven Electricity Costs, Blue Hill, MA.	32
18. Effect of Recurring Cost Ratio on Annualized System — Resultant Cost Ratio	33
19. Photovoltaic STES Concept for a Large Shopping Center in Albuquerque, NM.	112
20. Solar Thermal STES Concept (Rankine Cycle) for a Large Shopping Center in Albuquerque, NM	114
21. Cumulative Market Potential as a Function of Breakeven Electricity Costs.	118
22. State and Regional Monthly Power Costs	120
23. Breakeven Electricity Cost vs Local Electricity Cost	123
24. Breakeven Electricity Cost vs Local Electricity Cost	124
25. Time for Adoption of a New Product	126
26. Discrete Market Diffusion Rate Characteristics	131
27. Typical Diffusion Rates.	132
28. Effect of New Construction Penetration Rates on Time to Achieve Adoption	134
29. Commercial Sector Market Penetration Potential by STES	136
30. Project Utilization Plan Logic	138
31. STED Work Breakdown Structure.	146

FOREWORD

This is the final report for the Commercial Applications of Solar Total Energy Systems (STES) Program, developed under the Department of Energy (DOE) Contract EY-76-C-03-1210 [formerly, Energy Research and Development Administration (ERDA) Contract E(04-03)-1210]. The work was performed by Atomics International (AI) Division of Rockwell International Corporation, during the period from May 10, 1976 through June 1978. The technical effort was completed June 1, 1977; however, the final report was delayed due to requested changes to the preliminary report and the required authorization to revise the report during the period of ERDA transition to DOE.

The work is reported in four volumes as follows:

Volume 1 — Summary

Volume 2 — Technical

Volume 3 — Conceptual Designs and Market Analyses

Volume 4 — Appendices

The study was performed in the Advanced Programs Department of AI, under S. J. Nalbandian, Project Manager with support primarily from the following Rockwell personnel:

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In addition two subcontractors provided support relating to building configurations, energy demand, building codes and conventional total energy systems. They were the Envirodyne Energy Services and The Energy Group, a subsidiary of Welton-Becket Associates.

The DOE (Washington, D.C.) Program Manager was Mr. J. E. Rannels. Technical direction for the study was provided by Dr. R. W. Harrigan, Technical Monitor, of Sandia Laboratories, Albuquerque, New Mexico.

Figure 1. Solar Thermal STES Concept Block Diagram

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1.0 INTRODUCTION AND SUMMARY

The overall objective of this program was to assess the feasibility of using solar energy to provide a significant fraction of the energy needs of commercial buildings that have energy demands greater than 200 kWe. The 200-kWe limit was arbitrarily established to provide applications which reasonably could be expected to economically justify an onsite power generation system. Specific program objectives are presented in Section 1.2, Volume 1. Section 2, Volume 2 provides a summary of the methodology used to meet the program objectives.

A solar total energy system (STES) is one that provides a combination of electrical and thermal power to the user to supplement or replace conventional energy sources. Figures 1 and 2 show the generic concepts considered for this program.

As indicated in Figure 1, a solar thermal STES utilizes a concentrating solar collector to produce a high-temperature fluid which supplies energy to a power conversion system (PCS) and/or hot thermal energy storage for later use to power the PCS. The electrical energy produced by the PCS is used to supply the user's electrical demand loads (lighting, vapor compression chillers, etc.) and/or an electrical energy storage system. Rejected thermal energy from the PCS can be cascaded to supply the user's thermal demand loads and/or absorption chiller refrigeration units with all excess energy exhausted to the atmosphere primarily through a cooling tower.

Figure 2 shows schematically how a photovoltaic STES can consist of (1) direct conversion of the solar energy to electricity by photovoltaic arrays, which may or may not involve concentrators, and (2) collection of low grade thermal energy either from the cooling of concentrating photovoltaic arrays or by separate flat plate solar collectors which supply the user's thermal demand loads.

Figures 1 and 2 show energy storage in several places to indicate the numerous options possible in configuring the systems and which need to be evaluated to determine the most economical configuration for a given application. This evaluation can be expensive for conceptual design studies if a detailed computer program such as SOLSYS,^{(1)*} PVSOLSYS,⁽²⁾ or modified TRNSYS⁽³⁾ is used. Thus, an

*Numbers in superscript parenthesis refer to references.

Figure 2. Photovoltaic STES Concept Block Diagram

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alternate method of developing the economical optimum STES configuration was felt to be needed to assess applicability of various STES concepts and building configurations at different site locations within the continental United States.^(4,5)

The STESEP Computer Code (see Section 5, Volume 2) was developed for a quick evaluation method for tradeoffs related to (1) cascading of thermal power conversion systems, (2) determination of optimum collector sizes and operating conditions (make or buy decisions for auxiliary energy), and (3) comparison of solar total energy concepts in various parts of the country and in various types of commercial buildings to assess their future economic potential for various economic scenarios.

The individual STES component-subsystem models are of necessity simplified and are used together with a deterministic model (see Section 4.2, Volume 2) of the solar-environmental site condition to enable screening calculations to be made inexpensively. The results from these screening calculations defined the economics of the system and were used directly for conceptual trend studies as discussed in Sections 2 and 3 of this volume.

Concurrently, data on commercial buildings (e.g., categories, energy demand, demographic population, etc.) were developed and used to define six model building configurations (see Section 4.6, Volume 2) which could be used as representative commercial buildings within six climatic regions (12 specific sites) of the United States. The six configurations (see Table 41 in Volume 2) included four building types (a low rise office building, a large retail store, a medium-size shopping center and a large shopping center) typifying current building designs. The remaining two configurations used the large shopping center model except that the energy demand was changed to reflect future building designs. One assumed retrofitting the existing large shopping center model with an energy conservation program while the other assumed a new construction of a shopping center designed to meet expected future energy conservation codes.

This volume of the final report discusses the STES concept trade studies, sensitivity parameters, performance characteristics, and selected concepts. Market and penetration rate estimates are provided in Section 4 while technology advancements and utilization plans are discussed in Section 5.

2.0 EVALUATION OF SOLAR TOTAL ENERGY SYSTEMS (STES) CONCEPTS

The cost effectiveness of a STES for commercial buildings will depend on a number of parameters including the operating mode of the STES, the building size, location in the United States, and when the system is expected to commence operation. This section discusses the studies made to define these effects. In the comparisons that follow, the breakeven cost of electricity (B.E.C.E.) is used as the primary comparison parameter as defined in Section 5, Volume 2. It is the cost of utility grid electricity at which the STES and reference system costs would be equivalent. A upper limit for the B.E.C.E. was estimated using the JPL/ERDA cost parameters.⁽⁶⁾ The lower limit for the B.E.C.E. was estimated using a fuel escalation rate of 10% with all other parameters fixed. It was assumed that these limits should bracket the economic conditions likely to be experienced. It should be noted that the B.E.C.E. is independent of the local costs of electricity, but the cost effectiveness of the STES is strongly dependent on the local electricity cost since the local cost of electricity must be higher for the STES to be cost effective. The parameter used to describe the cost effectiveness of the STES in a given application is the delta return on investment (Δ ROI) which is based on the incremental change in annualized cost as described in Section 5, Volume 2. The selected concept configurations for the six model building configurations for the twelve sites are shown in Section 3.

Besides the breakeven cost of electricity for the STES, an estimate of the solar energy contribution from the STES is desirable to estimate both risk factors and fuel savings. However, to establish the relative worth of high grade energy (electricity) and low grade thermal energy (cascaded heat) is a controversial task. The approach used during this study was to consider the cost of each type of energy and generate three contribution terms:

- 1) Fossil Contribution = cost of purchased fossil fuel divided by the cost to buy all energy for the reference building
- 2) Utility Contribution = cost of purchased electricity divided by the cost to buy all energy for the reference building

reject energy from the PCS: (1) to supply both heating and cooling (total cascading) by operating the turbine condenser at 105°C (221°F) or above; (2) to supply the building heating and process heat requirements with the turbine condenser operated at 60°C (140°F) or above. A wet cooling tower was not considered desirable in this study; therefore, lower condenser temperatures were eliminated. To illustrate the effect of these two cascading options, a simplified model relating the value of thermal and electrical energy was used to obtain the ratio of purchased power costs for commercial buildings (with cascading as defined above) to purchasing all power for the buildings. The model buildings used for this study have a cooling demand load about five times the heating demand load (see Appendix D) and a heating demand load between about 1/2 to 1 times the electrical load. For these conditions, Figure 4 shows the percentage savings in purchased power costs for both total cascading and cascading for heating only for two different ratios of the cost of electrical energy to the cost of thermal energy that are representative of locations in the northeast U.S.A. (5:1) and the remaining portion of the country (3:1). These curves indicate that for heating to electrical load ratios below 0.6, total cascading in the northeast U.S.A. appears to be superior to cascading for heating only; however, in the rest of the country, cascading for heating only appears superior for all heating ratios because of the lower cost of electrical energy as compared to thermal

Figure 4. Effect of Heating Load to Electrical Load Ratio on Cascading PCS Thermal Energy

energy where driving a vapor compression chiller electrically is more economical than thermally driving an absorption chiller. Figure 5 shows this effect more clearly by considering a building with a 0.47 ratio of heating to electrical load that enables the electrical load to be met by the PCS for total cascading (heating and cooling) as well as cascading for heating only.

It can be seen that below a ratio of about 3 for the electrical energy cost to thermal energy cost, cascading for heating only provides a greater saving in purchased power. The more detailed calculations using the STESEP computer code, described in Section 5, Volume 2, also substantiate this selection with total cascading selected for Blue Hill, Washington, D.C., and Albuquerque while cascading for heating only provided the most cost effective STES at the remaining locations (Los Angeles and Madison are marginal). As fossil fuels become scarcer, it is expected that the ratio of the cost of electrical energy to thermal energy will tend to decrease and that STES configurations that cascade only for heating loads are the probable future applications.

Figure 5. Effect of Cost of Electrical Energy to Thermal Energy Ratio on Cascading PCS Thermal Energy

At the present time, however, the locations most favorable for STES applications are those which have high electricity costs. These locations generally have a high ratio of electrical-to-thermal energy costs, and hence, total cascading of the PCS energy produces the most cost effective systems. The first STES applications, therefore, will probably have totally cascaded energy systems, but later systems may cascade only for heating as the ratio of electrical-to-thermal energy decreases.

Also, referring to Figure 3, an option considered for the Rankine cycle STES was the use of fossil energy to increase the working fluid temperature above that available from the collector. This topping energy improves the PCS efficiency and was found to improve the cost effectiveness of the system in all cases. An additional temperature increase of 50°C (122°F) appeared to be optimum from a cost effectiveness viewpoint. However, this decreases the fossil fuel savings for the system and may only be desirable for applications where the ratio of electricity to thermal energy costs is high.

The relatively small amount of land area available for commercial building STES applications limits (refer to Section 5.3, Volume 2) the output power of the system and, in general, causes a poor utilization of storage, unless the storage system also has other uses. Consequently, there is not enough power to effectively operate in the electrical control mode (stand alone case, see Section 2.2, Volume 2). This poor use of storage, downgrades the thermal control mode because of storage losses over a large part of the year. Only the solar control mode which can use the battery system for load leveling in conjunction with storage appears suitable for commercial building STES. This is illustrated in Figure 6 where the B.E.C.E. for solar load control of a shopping center STES is compared for distributed collectors and central receivers as a function of turbine inlet temperature. These cases use total cascading of the PCS energy which would be best for the Blue Hill, Massachusetts location as discussed above. The curves indicate that increasing the turbine inlet temperature decreases the resultant cost of electricity up to turbine inlet temperatures of about 600°K (327°C) for both distributed collectors and central receivers. The central receiver is slightly more cost effective, but does not appear to have a significant advantage over the distributed collector in cost effectiveness for this

Figure 6. Comparison of Turbine Inlet Temperature Effects on Cascaded STES in Blue Hill, MA

application. The effects of "peak shaving" on the operating costs for these systems is shown in Figure 7 to be relatively small with an "optimum" operating condition indicated at 250 to 270 kWh/kW-mo. This is about 80% of the original energy usage-to-demand ratio. This "optimum" operating condition will vary with the size of the STES, but is indicative that economics will cause the STES user to maintain a reasonable load profile to the electrical utility.

In the discussion above, only the solar load control mode (see Section 2.2, Volume 2) has been considered. There are several reasons for selecting examples using the solar control mode since the land area available for STES usage in the commercial sector limits the STES output to a relatively small fraction of the buildings' total electrical demand (20 to 40%). The electrical control mode would therefore require a large amount of fossil fuel in a relatively inefficient STES PCS to maintain the "stand alone" requirement. This would therefore result in a less cost effective system than a conventional (no solar energy) total energy system (and might even consume more fuel).

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Figure 7. Effect of Energy Usage on Breakeven Cost of Electricity in Blue Hill, MA

2.2 BUILDING SIZE EFFECTS

The limited land area also precludes the effective use of thermal storage systems for these buildings since the surface to volume ratios for small storage tanks lead to very low thermal energy storage efficiencies. Consequently, the use of battery storage systems in the STES operated in the solar control mode appears to be the most favorable STES configuration for the commercial sector.

2.2.1 Organic Rankine STES

Regardless of the control mode selected, the operation and maintenance cost (O&M) for these Rankine cycle STES represents a significant portion of the breakeven cost of electricity as shown in Figure 8. In this figure the breakeven cost of electricity is shown as a function of the building installed power level for five of the six model building configurations. Within the accuracy of the simulation models used for this study, the type of model building configuration does not influence the economic aspects of the STES. However, the

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Figure 8. Effect of Installed STES Size on Breakeven Cost of Electricity (Rankine STES)

limited land area effects on storage efficiencies make systems providing 20% of the building load (and probably only using the roof area for collectors) more cost effective than systems providing 40% of the building electrical load.

2.2.2 Photovoltaic STES

To a lesser extent the above conclusions also apply to photovoltaic STES concepts represented by Figure 9 (see List of Symbols, page 151 for definition of terms). Figure 10 shows the breakeven cost of electricity as a function of the installed electrical power for the buildings using the nontracking photovoltaic STES concept with flat plate solar collectors for the thermal energy requirements. This figure also shows that the cost effectiveness of these photovoltaic STES using a significant amount of batteries for storage is more sensitive to the economic parameters than Rankine cycle STES. Consequently, the selected concepts for both Rankine cycle and photovoltaic STES shown in Section 3 were obtained by rerunning all cases to allow selection of STES configurations that provided an "optimum" amount of power for each model building/location pair. The Rankine cycle STES runs also evaluated total versus partial cascading of energy for each building/location pair.

Since building/system size effects were found to be more important than building type (i.e., shopping center versus office building), the remaining discussion is concentrated on a large shopping center application.

2.3 PARAMETRIC EFFECTS

Comparative evaluation of the economic merits of the candidate systems, as well as projections of the initial date and rate of market penetration, are dependent upon the various assumptions used in developing the candidate system breakeven cost data. Data developed on breakeven cost of electricity sensitivities included:

- 1) effect of location
- 2) effect of escalation rates and project start year
- 3) variations in collector, battery operations, and maintenance cost
- 4) installed system size effects
- 5) "financial parameters"

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Figure 9. Diagram of Photovoltaic STES Concept

Figure 10. Effect of Installed STES Size on Breakeven Cost of Electricity (Photovoltaic STES)

2.3.1 Effect of Location on Collector Efficiency

While no effect of site location on the breakeven cost of electricity was observed, there were definite effects found for the operational efficiencies of the collectors. In particular, the concentrating collectors exhibited a three to one variation in overall efficiency as shown in Figure 11, although the optimum operating conditions did not vary significantly. For the flat plate solar collector used to supply the heating load for the photovoltaic concept, the variation was much less since the low temperature needed for heating allowed efficient operation most of the time.

A surprising conclusion from these results is the small effect location has on the breakeven cost of electricity from the STES. The large variations in the local cost of electricity can make STES in the northeast (where collector efficiencies will be low) more cost effective than STES in the southwest (where collector efficiencies are high). Also the larger heating loads in the lower insolation regions coupled with lower cooling loads make up for poorer collector efficiencies and give a resultant breakeven cost of electricity that is relatively independent of site location as shown in Figure 12. This figure shows the breakeven cost of electricity for a large shopping center as a function of a correlation parameter. Site differences in weather conditions were exaggerated to illustrate that no obvious detrimental effect of weather exists on STES breakeven electricity costs for commercial buildings.

2.3.2 Effect of Escalation Rates and Project Start Year

The effect of escalation rates and project start year on the breakeven costs for a large shopping center in Blue Hill, MA, for the organic Rankine STES and the photovoltaic STES are shown in Figure 13. The breakeven cost appears far more sensitive to escalation rates than the assumed start year. The fuel, operating, and maintenance (F,O&M) costs recur annually, as does the cost of purchased electricity, and were assumed to escalate at a rate of 6 to 12% for the life of the system. The general inflation rate used was 5% for the capital ("nonrecurring") costs, which was applied only from the base year (1976) to the assumed project start year. The photovoltaic STES appeared to be significantly more sensitive to escalation rate and start year variations than the organic Rankine STES.

1 = SEATTLE	5 = WASHINGTON, DC	9 = LAKE CHARLES, LA
2 = MADISON, WI	6 = OMAHA, NE	10 = FORT WORTH, TX
3 = BLUE HILL, MA	7 = ALBUQUERQUE, NM	11 = PHOENIX, AZ
4 = LOS ANGELES, CA	8 = NASHVILLE, TN	12 = MIAMI, FL

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Figure 11. Effect of Location on Collector Efficiency

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Figure 12. Large Shopping Center (70,755 m²) Effect of Location on Electricity Breakeven Cost

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Figure 13. Effect of Escalation Rates and Project Start Year on Breakeven Electricity Costs for a Large Shopping Center (70,755 m²), Blue Hill, MA

For a recurring cost escalation of 6% and a start year of 1986,⁽⁶⁾ the breakeven costs of electricity for the organic Rankine STES were ~7 ¢/kWh; for the case where the recurring escalation rate was 10% and the start year was 2006, the breakeven cost is ~5 ¢/kWh. Comparable photovoltaic STES breakeven costs were ~10 and ~4 ¢/kWh. These differences may be attributed to the fact that the capital investment for the organic Rankine STES was on the order of half (1976 dollars) that for the photovoltaic system; annual recurring costs for the organic Rankine cycle were on the order of 10% higher. At a 6% F, O&M escalation rate, capital costs dominate the examples chosen and the nominally lower photovoltaic STES recurring costs are enough to overcome the appreciably higher capital requirements. In any case, it appears that both cycles can produce electricity competitively in the northeast in 20 years, if we experience high escalation rates in recurring costs.

2.3.3 Sensitivity of the Breakeven Cost of Electricity

The two economic scenerios described above were selected to compare the effects of various cost parameters on the breakeven cost of electricity (B.E.C.E.) of the STES.

Figure 14 shows the sensitivity of the B.E.C.E. to the cost of the collector (array) for both types of STES. The greater sensitivity of the photovoltaic STES is again shown and indicates that solar thermal systems are probably preferable under the low escalation conditions while photovoltaic systems are preferable in high escalation conditions prevail for the reasons given in Section 2.3.2.

Figure 15 shows the effect of battery costs on photovoltaic STES B.E.C.E. to indicate a relatively small influence (primarily because of the small quantities of storage needed by the system).

Figure 16 shows the sensitivity of the B.E.C.E to the operations and maintenance costs for both systems. As can be seen for the Rankine cycle STES, the assumed operations and maintenance costs (O&M) account for over half of the breakeven electricity costs for the organic Rankine STES (e.g., the difference between 100% O&M costs and 0% O&M costs) primarily due to operational requirements (e.g., operators) for a Rankine collector system which employs high-pressure, flammable, and potentially toxic working fluid as compared to the

77-MA25-55-14A

Figure 14. Effect of Collector Cost on Breakeven Electricity Cost for a Large Shopping Center (70,555 m²), Blue Hill, MA

77-MA25-55-15

Figure 15. Effect of Battery Costs on Breakeven Electricity Costs (Photovoltaic STES for a Large Shopping Center (70,555 m²), Blue Hill, MA)

77-MA25-55-16A

Figure 16. Effect of Operations and Maintenance Costs on Breakeven Electricity Costs for a Large Shopping Center (70,555 m²), Blue Hill, MA

"passive" solar photovoltaic systems. If the manpower required to operate the organic Rankine STES could be reduced, significant reductions in the breakeven costs could be realized. The operational manpower requirements for the photovoltaic system are significantly lower and, hence, the B.E.C.E. is less sensitive to operations and maintenance costs. (See Section 5 of this volume for discussion of these costs.)

Figure 17 shows the relative effects of the B.E.C.E. as a function of system size. Larger systems afford economies of scale in equipment costs and manpower utilization.

2.3.4 Financial Parameters

The sensitivity of the annualized system cost ($\overline{AC}$) to variations in the following "financial parameters" were evaluated and are discussed in Appendix G, Volume 4.

- 1) Weighted average, after-tax cost capital (k)
- 2) System lifetime (N) and/or accounting lifetime
- 3) Effective corporate income tax rate and investment tax credit
- 4) Type of depreciation (straight line or sum of digits)
- 5) Inflation or escalation rates (g)
- 6) Annualized system-resultant cost ratio (equals annualized cost divided by the capital investment $[\overline{AC}/CI]$)
- 7) Recurring cost ratio (equals fuel, operating, and maintenance cost divided by the capital investment $[(O\&M + F)/CI]$).

The results shown in Figure 18 indicate that the annualized system-resultant cost ratio increases exponentially as the recurring cost ratio increases. For capital-intensive systems such as solar, nuclear, and hydro, which may be characterized by low recurring cost ratios ($\lesssim 5\%$), the annualized cost ratio is equal to about 0.2 to 0.3 over a range of "money costs" (k) which vary from 8 to 10.5%, inflation rates (g) ranging from 5 to 11%, and system lifetimes (N) of 20 to 30 years. As the recurring cost ratio increases (e.g., fossil fuel systems), the annualized ratio rises most rapidly for the combination which represents the

77-MA25-55-17A

Figure 17. Effect of STES Size on Breakeven Electricity Costs, Blue Hill, MA

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Figure 18. Effect of Recurring Cost Ratio on Annualized System — Resultant Cost Ratio

highest N and g , and the lowest k . The "drivers" appear to be the system life-time and projected inflation rate. Typically, the capital investment ratios are dependent upon the anticipated inflation rates and system lifetimes.

The implications of these data are that in an uncertain or unstable economic environment (e.g., where the impact of inflation on recurring fuel, operations, and maintenance costs over the life of the project is unpredictable), the "safer" or more conservative approach might be to pay for the system "up front" with a larger capital investment in order to minimize the recurring costs and, therefore, improve the confidence in the annualized cost projections over the life of the project. For example, if the recurring cost ratio were on the order of 5%, the annualized system-resultant cost ratio would be on the order of 0.2 to 0.3 (regardless of the cost of money, inflation rate, or system lifetime). If, on the other hand, the recurring cost ratio were on the order of 50%, such as in a coal-fired intermediate plant (this ratio might be on the order of 1 to 2.5 for gas turbine plants), then the annualized system-resultant cost ratio would exceed unity (and could be in excess of 2 for a 30-year plant which experiences escalation in annual recurring costs on the order of 10% or more). Typically, given the option, one could invest four times more in a plant where the recurring costs were minimized as compared to one which the recurring costs might be subject to an inflation rate of 8% annually (or more) over 30 years.

2.4 CONCEPT EVALUATION AND SENSITIVITY ANALYSIS CONCLUSIONS

The concept evaluation studies have indicated that a single STES configuration suitable for all applications does not exist and that the local costs of electrical and fossil fuel energy play a dominant role in determining the most cost effective STES configuration for commercial buildings.

The land locked nature of commercial buildings limits the power capability of the STES and produces systems with poor utilization of energy storage systems. This in turn makes the systems using "on site" backup with fossil fuel or off peak purchased power the most cost effective systems.

For locations with a high cost ratio of electrical-to-fossil energy, Rankine cycle systems should drive absorption cycle chillers with the PCS reject heat which locations with a low cost ratio favor use of the reject energy for heating only.

The operation and maintenance costs for these systems are two of the primary variables affecting the cost effectiveness of STES as are the future economic trends of fuel costs.

On-site backup systems for commercial building STES can solve the most probable utility interface problems satisfactorily.

3.0 SELECTED CONCEPT CONFIGURATIONS

The six model buildings and 12 sites were analyzed using the STESEP code to define STES configurations for the photovoltaic concept and the Rankine cycle concept. These analyses compared control and operating parameters for the systems as discussed in Section 2 to determine the most cost effective configuration for each application. The selected concept configurations for each building are listed below in the following pages. Section 3.1 contains the selected photovoltaic STES configurations, while Section 3.2 contains the Rankine cycle thermal STES configurations.

3.1 PHOTOVOLTAIC STES CONFIGURATIONS

Pages 38 to 43 show the STES configurations selected for the large shopping center located in the 12 sites which are in alphabetical order by city name.

Pages 44 to 49 show the STES configurations selected for an energy conserving large shopping center retrofit for the 12 site locations.

Pages 50 to 55 show the STES configurations selected for a large shopping center constructed to the new standard (ASHRAE 90-75) located at the 12 site locations.

Pages 56 to 61 show the STES configurations selected for a medium shopping center located at the 12 sites.

Pages 62 to 67 show the STES configuration selected for a large retail store located at the 12 sites.

Pages 68 to 73 show the STES configuration selected for a low rise office building that is located at the 12 sites.

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 70755.50.M AND ELECTRICAL DEMAND IS 101000.KWH/DAY AT 306.KWH/KW
BASED ON INCIDENT INSULATION OF 616.LANG./DAY, HDD/YR OF 4418. CDD/YR OF 1437.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.086 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.40 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	SIZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	42480. SM	0.120	0.	0.	35444.	100.	4248.	0.	20.	
BATTERY	656. KWH	0.723	0.	0.	231.	50.	33.	7.	20.	
AUX.ELFC	12200. KW	1.000	0.	0.	107489.	0.	0.	1223.	20.	
BLDG.HT.	430. KW	1.000	19.	19.	63348.	25.	11.	29.	20.	
INVERT.	4744. KW	0.950	0.	0.	0.	65.	308.	112.	20.	
V.C.RFG.	9300. TON	4.500	0.	0.	294010.	240.	2234.	0.	20.	
AH. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.	
PRO.HTG.	7426. KW	1.000	0.	0.	2534.	5.	36.	0.	20.	
FP COLL.	28312. SM	0.537	60.	69.	105935.	54.	1523.	0.	20.	
HEAT STD	43023. CM	0.700	60.	60.	0.	6.	236.	0.	20.	

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 26.1% OF LOAD, UTILITY 72.2%, AND FOSSIL FUEL 1.7%
TOTAL CAP. INV. IS \$.86298E+07 WITH YEARLY REC'G. COSTS, .13704E+07
ANNUALIZED COST OF \$.15150E+08 WITH A YEARLY SAVING OF .23025E+07 DROI= 13.2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 70755.50.M AND ELECTRICAL DEMAND IS 136065.KWH/DAY AT 314.KWH/KW
BASED ON INCIDENT INSULATION OF 497.LANG./DAY, HDD/YR OF 6051. CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.086 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=12.73 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE	K\$	YEARS
PV ARRAY	42484. SM	0.126	0.	0.	30236.	100.	4248.	0.	20.
BATTERY	466. KWH	0.723	0.	0.	160.	50.	23.	5.	20.
AUX.ELFC	12203. KW	1.000	0.	0.	107383.	0.	0.	1814.	20.
BLDG.HT.	430. KW	1.000	19.	19.	69137.	25.	11.	87.	20.
INVERT.	4205. KW	0.950	0.	0.	0.	65.	273.	107.	20.
V.C.RFG.	8280. TON	4.500	0.	0.	271357.	251.	2082.	0.	20.
AH. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	8371. KW	1.000	0.	0.	2534.	4.	38.	0.	20.
FP COLL.	28302. SM	0.449	60.	69.	71567.	54.	1523.	0.	20.
HEAT STD	26945. CM	0.700	69.	60.	0.	7.	191.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 20.2% OF LOAD, UTILITY 76.1%, AND FOSSIL FUEL 3.7%
TOTAL CAP. INV. IS \$.83887E+07 WITH YEARLY REC'G. COSTS, .20140E+07
ANNUALIZED COST OF \$.21564E+08 WITH A YEARLY SAVING OF .27651E+07 DROI= 11.4%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 149453.KWH/DAY AT 307.KWH/KW
BASED ON INCIDENT INSULATION OF 520.LANG./DAY, HDD/YR OF 2571, CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 2.60 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	14161. SM	0.121	0.	0.	10075.	100.	1416.	0.	20.
BATTERY	5. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX. FLEC	13713. KW	1.000	0.	0.	139841.	0.	0.	458.	20.
BLDG. HT.	430. KW	1.000	19.	19.	56196.	25.	11.	14.	20.
INVERT.	1370. KW	0.950	0.	0.	0.	65.	89.	89.	20.
V.C. RFG.	10214. TON	4.500	0.	0.	331603.	232.	2366.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	7234. KW	1.000	0.	0.	2534.	5.	33.	0.	20.
FP COLL.	35377. SM	0.525	60.	60.	109449.	54.	1904.	0.	20.
HEAT STD	54882. CM	0.700	69.	60.	0.	5.	275.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 32.4% OF LOAD, UTILITY 65.5%, AND FOSSIL FUEL 2.1%
TOTAL CAP. INV. IS \$.60942E+07 WITH YEARLY REC'G. COSTS, .56188E+06
ANNUALIZED COST OF \$.66297E+07 WITH A YEARLY SAVING OF .86911E+06 DROI= 11.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 148854.KWH/DAY AT 316.KWH/KW
BASED ON INCIDENT INSULATION OF 485.LANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.16 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	42484. SM	0.122	0.	0.	28429.	100.	4248.	0.	20.
BATTERY	335. KWH	0.723	0.	0.	76.	50.	17.	3.	20.
AUX. ELEC	13255. KW	1.000	0.	0.	121867.	0.	0.	820.	20.
BLDG. HT.	430. KW	1.000	19.	19.	52257.	25.	11.	8.	20.
INVERT.	3831. KW	0.950	0.	0.	0.	65.	249.	106.	20.
V.C. RFG.	9626. TON	4.500	0.	0.	328909.	237.	2282.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	6408. KW	1.000	0.	0.	2534.	5.	32.	0.	20.
FP COLL.	28362. SM	0.515	60.	60.	80122.	54.	1523.	0.	20.
HEAT STD	30125. CM	0.700	69.	60.	0.	7.	202.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.6% OF LOAD, UTILITY 71.6%, AND FOSSIL FUEL 0.7%
TOTAL CAP. INV. IS \$.85639E+07 WITH YEARLY REC'G. COSTS, .93785E+06
ANNUALIZED COST OF \$.10803E+08 WITH A YEARLY SAVING OF .11489E+07 DROI= 9.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 13900.KWH/DAY AT 315.KWH/KW
BASED ON INCIDENT INSULATION OF 533.LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.040 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 7.41 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	42484. SM	0.121	0.	0.	31066.	100.	4248.	0.	20.
BATTERY	592. KWH	0.723	0.	0.	147.	50.	30.	6.	20.
AUX.ELEC	12477. KW	1.000	0.	0.	109994.	0.	0.	1050.	20.
BLDG.MT.	430. KW	1.000	19.	19.	52245.	25.	11.	6.	20.
INVERT.	4380. KW	0.950	0.	0.	0.	65.	285.	108.	20.
V.C.RFG.	8631. TON	4.500	0.	0.	246381.	247.	2135.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	6736. KW	1.000	0.	0.	2534.	5.	32.	0.	20.
FP COLL.	28302. SM	0.520	60.	69.	88755.	54.	1523.	0.	20.
HEAT STO	40363. CM	0.700	69.	60.	0.	6.	235.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 28.0% OF LOAD, UTILITY 71.5%, AND FOSSIL FUEL 0.4%
TOTAL CAP. INV. IS \$.84979E+07 WITH YEARLY REC'G. COSTS, .11699E+07
ANNUALIZED COST OF \$.13119E+08 WITH A YEARLY SAVING OF .20337E+07 DROI= 13.4%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN MADISON, WIS.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 135960.KWH/DAY AT 312.KWH/KW
BASED ON INCIDENT INSULATION OF 516.LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.040 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.02 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	35404. SM	0.127	0.	0.	26183.	100.	3540.	0.	20.
BATTERY	340. KWH	0.723	0.	0.	110.	50.	17.	3.	20.
AUX.ELEC	12273. KW	1.000	0.	0.	111116.	0.	0.	1201.	20.
BLDG.MT.	430. KW	1.000	19.	19.	75265.	25.	11.	111.	20.
INVERT.	3467. KW	0.950	0.	0.	0.	65.	225.	104.	20.
V.C.RFG.	8370. TON	4.500	0.	0.	270887.	250.	2095.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	8916. KW	1.000	0.	0.	2534.	4.	39.	0.	20.
FP COLL.	35377. SM	0.447	60.	69.	92439.	54.	1904.	0.	20.
HEAT STO	45140. CM	0.700	69.	60.	0.	6.	249.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.3% OF LOAD, UTILITY 73.9%, AND FOSSIL FUEL 6.8%
TOTAL CAP. INV. IS \$.80808E+07 WITH YEARLY REC'G. COSTS, .14192E+07
ANNUALIZED COST OF \$.15550E+08 WITH A YEARLY SAVING OF .11827E+07 DROI= 7.1%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN MIAMI, FLA.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 156941.KWH/DAY AT 335.KWH/KW
BASED ON INCIDENT INSULATION OF 525.LANG./DAY, HDD/YR OF 186. CDD/YR OF 3958.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.75 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT	SIZE K\$	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	42484. SM	0.119	0.	0.	30014.	100.	4248.	0.	20.	
BATTERY	317. KWH	0.723	0.	0.	46.	50.	16.	3.	20.	
AUX. ELEC	13178. KW	1.000	0.	0.	128440.	0.	0.	947.	20.	
BLDG. HT.	430. KW	1.000	19.	19.	49685.	25.	11.	0.	20.	
INVERT.	3979. KW	0.950	0.	0.	0.	65.	259.	107.	20.	
V.C. RFG.	9529. TON	4.500	0.	0.	365297.	238.	2268.	0.	20.	
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.	
PRO. HTG.	6575. KW	1.000	0.	0.	2534.	5.	31.	0.	20.	
FP COLL.	28302. SM	0.557	60.	69.	93737.	54.	1523.	0.	20.	
HEAT STO	32941. CM	0.700	69.	60.	0.	6.	211.	0.	20.	

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.1% OF LOAD, UTILITY 72.9%, AND FOSSIL FUEL 0.0%

TOTAL CAP. INV. IS \$.85671E+07 WITH YEARLY REC'G. COSTS, .10572E+07

ANNUALIZED COST OF \$.12000E+08 WITH A YEARLY SAVING OF .14812E+07 DROI= 11.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 143422.KWH/DAY AT 308.KWH/KW
BASED ON INCIDENT INSULATION OF 468.LANG./DAY, HDD/YR OF 3632. CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 4.39 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE.	K\$	YEARS
PV ARRAY	14161. SM	0.125	0.	0.	9345.	100.	1416.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX.ELEC	13133. KW	1.000	0.	0.	134544.	0.	0.	737.	20.
BLDG.HT.	430. KW	1.000	19.	19.	60582.	25.	11.	44.	20.
INVERT.	1290. KW	0.950	0.	0.	0.	65.	84.	88.	20.
V.C.RFG.	9471. TON	4.500	0.	0.	304465.	239.	2259.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	7654. KW	1.000	0.	0.	2534.	5.	35.	0.	20.
FP COLL.	35377. SM	0.471	60.	69.	88214.	54.	1904.	0.	20.
HEAT STO	38761. CM	0.700	69.	60.	0.	6.	230.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 22.5% OF LOAD, UTILITY 73.1%, AND FOSSIL FUEL 4.4%

TOTAL CAP. INV. IS \$.59390E+07 WITH YEARLY REC'G. COSTS, .87012E+06

ANNUALIZED COST OF \$.96949E+07 WITH A YEARLY SAVING OF .88092E+06 DROI= 8.3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN OMAHA, NEB.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 141142.KWH/DAY AT 303.KWH/KW
BASED ON INCIDENT INSOLATION OF 522.LANG./DAY, HDD/YR OF 5459, CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 4.38 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE. K\$	K\$	YEARS
PV ARRAY	28323. SM	0.124	0.	0.	20751.	100.	2832.	0.	20.
BATTERY	47. KWH	0.723	0.	0.	6.	50.	2.	0.	20.
AUX.ELEC	13127. KW	1.000	0.	0.	121430.	0.	0.	678.	20.
BLDG.HT.	430. KW	1.000	19.	19.	67381.	25.	11.	54.	20.
INVERT.	2828. KW	0.950	0.	0.	0.	65.	184.	99.	20.
V.C.RFG.	9463. TON	4.500	0.	0.	294206.	239.	2258.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD.HTG.	8299. KW	1.000	0.	0.	2534.	4.	37.	0.	20.
FP COLL.	35377. SM	0.483	60.	69.	100931.	54.	1904.	0.	20.
HEAT STO	43702. CM	0.700	69.	60.	0.	6.	244.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 28.4% OF LOAD, UTILITY 66.3%, AND FOSSIL FUEL 5.3%

TOTAL CAP. INV. IS \$.74732E+07 WITH YEARLY REC'G. COSTS, .83104E+06

ANNUALIZED COST OF \$.95538E+07 WITH A YEARLY SAVING OF .11553E+07 DROI= 10.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 153836.KWH/DAY AT 304.KWH/KW
BASED ON INCIDENT INSOLATION OF 740.LANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.96 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE. K\$	K\$	YEARS
PV ARRAY	42484. SM	0.109	0.	0.	38734.	100.	4248.	0.	20.
BATTERY	802. KWH	0.723	0.	0.	139.	50.	40.	0.	20.
AUX.ELFC	14236. KW	1.000	0.	0.	117089.	0.	0.	920.	20.
BLDG.HT.	430. KW	1.000	19.	19.	54663.	25.	11.	15.	20.
INVERT.	6464. KW	0.950	0.	0.	0.	65.	420.	115.	20.
V.C.RFG.	10882. TON	4.500	0.	0.	351326.	226.	2459.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD.HTG.	6894. KW	1.000	0.	0.	2534.	5.	32.	0.	20.
FP COLL.	28302. SM	0.623	60.	69.	147647.	54.	1523.	0.	20.
HEAT STO	66983. CM	0.700	69.	60.	0.	5.	305.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 30.0% OF LOAD, UTILITY 68.9%, AND FOSSIL FUEL 1.1%

TOTAL CAP. INV. IS \$.90387E+07 WITH YEARLY REC'G. COSTS, .10582E+07

ANNUALIZED COST OF \$.12087E+08 WITH A YEARLY SAVING OF .18050E+07 DROI= 13.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 133659.KWH/DAY AT 322.KWH/KW
BASED ON INCIDENT INSOLATION OF 45H.LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 1.90 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	14161. SM	0.128	0.	0.	9363.	100.	1416.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX.ELEC	11706. KW	1.000	0.	0.	124764.	0.	0.	300.	20.
BLDG.MT.	430. KW	1.000	19.	19.	65380.	25.	11.	62.	20.
INVERT.	1283. KW	0.950	0.	0.	0.	65.	83.	88.	20.
V.C.RFG.	7644. TON	4.500	0.	0.	260529.	259.	1983.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	7769. KW	1.000	0.	0.	2534.	5.	35.	0.	20.
FP COLL.	35377. SM	0.424	60.	69.	77745.	54.	1904.	0.	20.
HEAT STD	35269. CM	0.700	69.	60.	0.	6.	219.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 36.4% OF LOAD, UTILITY 52.6%, AND FOSSIL FUEL 10.9%
TOTAL CAP. INV. IS \$.56511E+07 WITH YEARLY REC'G. COSTS, .45125E+06
ANNUALIZED COST OF \$.54481E+07 WITH A YEARLY SAVING OF .68248E+06 DROI= 11.1%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 140143.KWH/DAY AT 311.KWH/KW
BASED ON INCIDENT INSOLATION OF 48H.LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1285.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=12.29 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	42484. SM	0.125	0.	0.	29367.	100.	4248.	0.	20.
BATTERY	440. KWH	0.723	0.	0.	78.	50.	22.	4.	20.
AUX.ELEC	12687. KW	1.000	0.	0.	112265.	0.	0.	1853.	20.
BLDG.MT.	430. KW	1.000	19.	19.	62841.	25.	11.	63.	20.
INVERT.	3840. KW	0.950	0.	0.	0.	65.	250.	107.	20.
V.C.RFG.	8900. TON	4.500	0.	0.	289707.	244.	2175.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	7869. KW	1.000	0.	0.	2534.	5.	36.	0.	20.
FP COLL.	28302. SM	0.468	60.	69.	73306.	54.	1523.	0.	20.
HEAT STD	27536. CM	0.700	69.	60.	0.	7.	193.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 18.4% OF LOAD, UTILITY 79.0%, AND FOSSIL FUEL 2.7%
TOTAL CAP. INV. IS \$.84578E+07 WITH YEARLY REC'G. COSTS, .20272E+07
ANNUALIZED COST OF \$.21707E+08 WITH A YEARLY SAVING OF .22704E+07 DROI= 9.5%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN ALBUQUERQUE,N,M.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 69468,KWH/DAY AT 306,KWH/KW
BASED ON INCIDENT INSOLATION OF 616,LANG./DAY, HDD/YR OF 4418, CDD/YR OF 1437.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 8.41 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPL. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, KS	KS	YEARS
PV ARRAY	20964. SM	0.120	0.	0.	17490.	100.	2096.	0.	20.
BATTERY	324. KWH	0.723	0.	0.	114.	50.	16.	3.	20.
AUX,ELEC	6400. KW	1.000	0.	0.	52883.	0.	0.	603.	20.
BLDG,HT.	212. KW	1.000	19.	19.	31022.	28.	6.	14.	20.
INVERT.	2341. KW	0.950	0.	0.	0.	65.	152.	96.	20.
V.C.RFG.	4570. TON	4.500	0.	0.	144366.	317.	1449.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO,HTG.	3839. KW	1.000	0.	0.	1250.	5.	20.	0.	20.
FP COLL.	28302. SM	0.537	60.	69.	105935.	54.	1523.	0.	20.
HEAT STO	47122. CM	0.700	69.	60.	0.	5.	254.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 26.1% OF LOAD,UTILITY 72.2%,AND FOSSIL FUEL 1.7%

TOTAL CAP. INV. IS \$.55170E+07 WITH YEARLY REC'G.COSTS, .71611E+06

ANNUALIZED COST OF \$.80817E+07 WITH A YEARLY SAVING OF .58981E+06 DROI= 6.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 66984,KWH/DAY AT 314,KWH/KW
BASED ON INCIDENT INSOLATION OF 497,LANG./DAY, HDD/YR OF 6051, CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=12.71 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	SIZE, KS	CAP. INV. KS	REC'G CST. KS	CMPT. LIFE YEARS
PV ARRAY	20964. SM	0.126	0.	0.	14920.	100.	2096.	0.	20.	
BATTERY	230. KWH	0.723	0.	0.	79.	50.	12.	2.	20.	
AUX,ELEC	6007. KW	1.000	0.	0.	52831.	0.	0.	891.	20.	
BLDG,HT.	212. KW	1.000	19.	19.	33878.	28.	6.	18.	20.	
INVERT.	2075. KW	0.950	0.	0.	0.	65.	135.	94.	20.	
V.C.RFG.	4067. TON	4.500	0.	0.	133187.	332.	1349.	0.	20.	
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.	
PRO,HTG.	4108. KW	1.000	0.	0.	1250.	5.	22.	0.	20.	
FP COLL.	28302. SM	0.449	60.	69.	71567.	54.	1523.	0.	20.	
HEAT STO	32975. CM	0.700	69.	60.	0.	6.	211.	0.	20.	

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 22.4% OF LOAD,UTILITY 76.1%,AND FOSSIL FUEL 1.5%

TOTAL CAP. INV. IS \$.53540E+07 WITH YEARLY REC'G.COSTS, .10048E+07

ANNUALIZED COST OF \$.10949E+08 WITH A YEARLY SAVING OF .10713E+07 DROI= 8.9%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 73590, KWH/DAY AT 307, KWH/KW
BASED ON INCIDENT INSOLATION OF 520, LANG./DAY, HDD/YR OF 2371, CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 2,94 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZF.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	6988, SM	0,121	0,	0,	4971,	100,	699,	0,	20,
BATTERY	0, KWH	0,723	0,	0,	0,	0,	0,	0,	20,
AUX, ELEC	6752, KW	1,000	0,	0,	68868,	0,	0,	255,	20,
BLDG, HT,	212, KW	1,000	19,	19,	27493,	28,	6,	7,	20,
INVERT,	676, KW	0,950	0,	0,	0,	65,	44,	85,	20,
V.C. RFG,	5021, TON	4,500	0,	0,	162916,	306,	1534,	0,	20,
AB, RFG,	0, TON	0,650	0,	0,	0,	0,	0,	0,	20,
PRO, HTG,	3549, KW	1,000	0,	0,	1250,	5,	19,	0,	20,
FP COLL,	28302, SM	0,525	60,	69,	87591,	54,	1523,	0,	20,
HEAT STO	47862, CM	0,700	69,	60,	0,	5,	256,	0,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 29,9% OF LOAD, UTILITY 68,2%, AND FOSSIL FUEL 1,9%
TOTAL CAP. INV. IS \$,40814E+07 WITH YEARLY REC'G. COSTS, ,34667E+06
ANNUALIZED COST OF \$,41429E+07 WITH A YEARLY SAVING OF -77495, DROI= -1,9%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 73295, KWH/DAY AT 316, KWH/KW
BASED ON INCIDENT INSOLATION OF 485, LANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 5,20 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZF.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	20964, SM	0,122	0,	0,	14028,	100,	2096,	0,	20,
BATTERY	165, KWH	0,723	0,	0,	38,	50,	8,	2,	20,
AUX, ELEC	6526, KW	1,000	0,	0,	59978,	0,	0,	407,	20,
BLDG, HT,	212, KW	1,000	19,	19,	25550,	28,	6,	3,	20,
INVERT,	1890, KW	0,950	0,	0,	0,	65,	123,	93,	20,
V.C. RFG,	4731, TON	4,500	0,	0,	161587,	313,	1479,	0,	20,
AB, RFG,	0, TON	0,650	0,	0,	0,	0,	0,	0,	20,
PRO, HTG,	3337, KW	1,000	0,	0,	1250,	5,	18,	0,	20,
FP COLL,	28302, SM	0,515	60,	69,	80122,	54,	1523,	0,	20,
HEAT STO	36156, CM	0,700	69,	60,	0,	6,	222,	0,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27,7% OF LOAD, UTILITY 71,8%, AND FOSSIL FUEL 0,5%
TOTAL CAP. INV. IS \$,54763E+07 WITH YEARLY REC'G. COSTS, ,50427E+06
ANNUALIZED COST OF \$,59511E+07 WITH A YEARLY SAVING OF 36287, DROI= 0,6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 68631.KWH/DAY AT 315.KWH/KW
BASED ON INCIDENT INSOLATION OF 533.LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168.

ASSUMPTIONS:

FOR A 2006\$START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 7.63 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	SIZE. K\$	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	20964. SM	0.121	0.	0.	15300.	100.	2096.	0.	20.	
BATTERY	292. KWH	0.723	0.	0.	92.	50.	15.	3.	20.	
AUX.ELEC	6142. KW	1.000	0.	0.	54121.	0.	0.	532.	20.	
BLDG.HT.	212. KW	1.000	19.	19.	25543.	28.	6.	3.	20.	
INVERT.	2161. KW	0.950	0.	0.	0.	65.	140.	94.	20.	
V.C.RFG.	4240. TON	4.500	0.	0.	140601.	326.	1384.	0.	20.	
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.	
PRO.HTG.	3301. KW	1.000	0.	0.	1250.	6.	18.	0.	20.	
FP COLL.	28302. SM	0.520	60.	69.	88755.	54.	1523.	0.	20.	
HEAT STO	46421. CM	0.700	69.	60.	0.	5.	252.	0.	20.	

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.7% OF LOAD,UTILITY 71.8%,AND FOSSIL FUEL 0.4%
TOTAL CAP.INV. IS \$.54348E+07 WITH YEARLY REC'G.COSTS, .63166E+06
ANNUALIZED COST OF \$.72216E+07 WITH A YEARLY SAVING OF .48294E+06 DROI= 6.3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN MADISON, WIS.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 66932.KWH/DAY AT 312.KWH/KW
BASED ON INCIDENT INSOLATION OF 516.LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620.

ASSUMPTIONS:

FOR A 2006\$START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 8.12 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	SIZE.	CAP. INV. K\$	REC'G CST. K\$	CHPT. LIFE YEARS
PV ARRAY	20964. SM	0.127	0.	0.	15505.	100.	2096.	0.	20.	
BATTERY	283. KWH	0.723	0.	0.	101.	50.	14.	3.	20.	
AUX. ELEC	6041. KW	1.000	0.	0.	52231.	0.	0.	585.	20.	
BLDG. HT.	212. KW	1.000	19.	19.	36902.	28.	6.	28.	20.	
INVERT.	2053. KW	0.950	0.	0.	0.	65.	133.	94.	20.	
V.C. RFG.	4111. TON	4.500	0.	0.	132956.	330.	1358.	0.	20.	
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.	
PRO. HTG.	4377. KW	1.000	0.	0.	1250.	5.	23.	0.	20.	
FP COLL.	28302. SM	0.447	60.	69.	73951.	54.	1523.	0.	20.	
HEAT STO	39785. CM	0.700	69.	60.	0.	6.	233.	0.	20.	

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 24.1% OF LOAD,UTILITY 72.4%,AND FOSSIL FUEL 3.4%
TOTAL CAP.INV. IS \$.53867E+07 WITH YEARLY REC'G.COSTS, .71000E+06
ANNUALIZED COST OF \$.79992E+07 WITH A YEARLY SAVING OF .38432E+06 DROI= 4.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN MIAMI, FLA.
FLOOR AREA IS 70755.80,M AND ELECTRICAL DEMAND IS 77285,KWH/DAY AT 336,KWH/KW
BASED ON INCIDENT INSOLATION OF 525,LANG./DAY, HDD/YR OF 186, CDD/YR OF 3958.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 6.19 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZF.	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	20964, SM	0.119	0.	0.	14810.	100.	2096.	0.	20.
BATTERY	157, KWH	0.723	0.	0.	22.	50.	8.	2.	20.
AUX,ELEC	6488, KW	1.000	0.	0.	63222.	0.	0.	502.	20.
BLDG,HT.	212, KW	1.000	19.	19.	24282.	28.	6.	0.	20.
INVERT.	1963, KW	0.950	0.	0.	0.	65.	128.	93.	20.
V.C,RFG.	4683, TON	4.500	0.	0.	179544.	314.	1470.	0.	20.
AB, RFG.	0, TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO,HTG.	3221, KW	1.000	0.	0.	1250.	6.	18.	0.	20.
FP COLL.	28302, SM	0.557	60.	69.	93737.	54.	1523.	0.	20.
HEAT STO	38971, CM	0.700	69.	60.	0.	6.	230.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 26.2% OF LOAD,UTILITY 73.8%,AND FOSSIL FUEL 0.0%
TOTAL CAP.INV. IS \$.54796E+07 WITH YEARLY REC'G.COSTS, .59688E+06
ANNUALIZED COST OF \$.68802E+07 WITH A YEARLY SAVING OF .23973E+06 DROI= 3.4%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN NASHVILLE,TENN.
FLOOR AREA IS 70755.80,M AND ELECTRICAL DEMAND IS 70614,KWH/DAY AT 308,KWH/KW
BASED ON INCIDENT INSOLATION OF 468,LANG./DAY, HDD/YR OF 3632, CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 4.64 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZF.	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	6988, SM	0.125	0.	0.	4611.	100.	699.	0.	20.
BATTERY	0, KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX,ELEC	6466, KW	1.000	0.	0.	66234.	0.	0.	384.	20.
BLDG,HT.	212, KW	1.000	19.	19.	29657.	28.	6.	11.	20.
INVERT.	636, KW	0.950	0.	0.	0.	65.	41.	84.	20.
V.C,RFG.	4654, TON	4.500	0.	0.	149525.	315.	1465.	0.	20.
AB, RFG.	0, TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO,HTG.	3754, KW	1.000	0.	0.	1250.	5.	20.	0.	20.
FP COLL.	28302, SM	0.471	60.	69.	70571.	54.	1523.	0.	20.
HEAT STO	34682, CM	0.700	69.	60.	0.	6.	217.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 23.7% OF LOAD,UTILITY 74.2%,AND FOSSIL FUEL 2.1%
TOTAL CAP.INV. IS \$.39713E+07 WITH YEARLY REC'G.COSTS, .47888E+06
ANNUALIZED COST OF \$.54506E+07 WITH A YEARLY SAVING OF .38379. DROI= 0.7%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN OMAHA, NEB.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 69489.KWH/DAY AT 303.KWH/KW
BASED ON INCIDENT INSOLATION OF 522.LANG./DAY, HDD/YR OF 5459, CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006\$START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 4.60 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	20964, SM	0.124	0.	0.	15360.	100.	2096.	0.	20.
BATTERY	240, KWH	0.723	0.	0.	55.	50.	12.	2.	20.
AUX.ELEC	6463, KW	1.000	0.	0.	54913.	0.	0.	330.	20.
BLDG.MT.	212, KW	1.000	19.	19.	33012.	28.	6.	17.	20.
INVERT.	2093, KW	0.950	0.	0.	0.	65.	136.	94.	20.
V.C.RFG.	4650, TON	4.500	0.	0.	144462.	315.	1464.	0.	20.
AB, RFG.	0, TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	4073, KW	1.000	0.	0.	1250.	5.	21.	0.	20.
FP COLL.	28302, SM	0.483	60.	69.	80745.	54.	1523.	0.	20.
HEAT STO	38650, CM	0.700	69.	60.	0.	6.	229.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 33.3% OF LOAD,UTILITY 63.4%,AND FOSSIL FUEL 3.3%
TOTAL CAP.INV. IS \$.54886E+07 WITH YEARLY REC'G.COSTS, .44401E+06
ANNUALIZED COST OF \$.53489E+07 WITH A YEARLY SAVING OF .17698E+06 DROI= 3.2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 75753.KWH/DAY AT 304.KWH/KW
BASED ON INCIDENT INSOLATION OF 740.LANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464.

ASSUMPTIONS:

FOR A 2006\$START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 6.43 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	20964, SM	0.109	0.	0.	19114.	100.	2096.	0.	20.
BATTERY	396, KWH	0.723	0.	0.	69.	50.	20.	4.	20.
AUX.ELEC	7010, KW	1.000	0.	0.	57611.	0.	0.	489.	20.
BLDG.MT.	212, KW	1.000	19.	19.	26737.	28.	6.	7.	20.
INVERT.	3190, KW	0.950	0.	0.	0.	65.	207.	97.	20.
V.C.RFG.	5351, TON	4.500	0.	0.	172649.	298.	1595.	0.	20.
AB, RFG.	0, TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	3379, KW	1.000	0.	0.	1250.	5.	19.	0.	20.
FP COLL.	28302, SM	0.623	60.	69.	147647.	54.	1523.	0.	20.
HEAT STO	72723, CM	0.700	69.	60.	0.	4.	318.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 29.2% OF LOAD,UTILITY 69.8%,AND FOSSIL FUEL 1.1%
TOTAL CAP.INV. IS \$.57838E+07 WITH YEARLY REC'G.COSTS, .59731E+06
ANNUALIZED COST OF \$.69342E+07 WITH A YEARLY SAVING OF .41303E+06 DROI= 5.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 70755.SQ.M AND ELCTCRICAL DEMAND IS 65796.KWH/DAY AT 322.KWH/KW
BASED ON INCIDENT INSOLATION OF 458.LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 1.95 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	6988, SM	0.128	0.	0.	4620.	100.	699.	0.	20.
BATTERY	0, KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX,ELEC	5761, KW	1.000	0.	0.	61408.	0.	0.	151.	20.
BLDG,HT.	212, KW	1.000	19.	19.	32024.	28.	6.	17.	20.
INVERT.	633, KW	0.950	0.	0.	0.	65.	41.	84.	20.
V.C.RFG.	3753, TON	4.500	0.	0.	127845.	342.	1285.	0.	20.
AB, RFG.	0, TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO,HTG.	3811, KW	1.000	0.	0.	1250.	5.	20.	0.	20.
FP COLL.	28302, SM	0.424	60.	69.	62197.	54.	1523.	0.	20.
HEAT STO	31949, CM	0.700	69.	60.	0.	7.	208.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 40.7% OF LOAD,UTILITY 53.3%,AND FOSSIL FUEL 6.0%

TOTAL CAP.INV. IS \$.37820E+07 WITH YEARLY REC'G.COSTS, .25257E+06

ANNUALIZED COST OF \$.31505E+07 WITH A YEARLY SAVING OF -40070. DROI= -1.3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 70755.SQ.M AND ELCTCRICAL DEMAND IS 68996.KWH/DAY AT 311.KWH/KW
BASED ON INCIDENT INSOLATION OF 488.LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1285.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=12.44 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	20964, SM	0.125	0.	0.	14491.	100.	2096.	0.	20.
BATTERY	217, KWH	0.723	0.	0.	38.	50.	11.	2.	20.
AUX,ELEC	6246, KW	1.000	0.	0.	55240.	0.	0.	923.	20.
BLDG,HT.	212, KW	1.000	19.	19.	30772.	28.	6.	12.	20.
INVERT.	1895, KW	0.950	0.	0.	0.	65.	123.	93.	20.
V.C.RFG.	4373, TON	4.500	0.	0.	142242.	322.	1410.	0.	20.
AB, RFG.	0, TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO,HTG.	3860, KW	1.000	0.	0.	1250.	5.	21.	0.	20.
FP COLL.	28302, SM	0.468	60.	69.	73306.	54.	1523.	0.	20.
HEAT STO	33567, CM	0.700	69.	60.	0.	6.	213.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.9% OF LOAD,UTILITY 79.1%,AND FOSSIL FUEL 1.1%

TOTAL CAP.INV. IS \$.54036E+07 WITH YEARLY REC'G.COSTS, .10309E+07

ANNUALIZED COST OF \$.11219E+08 WITH A YEARLY SAVING OF .77583E+06 DROI= 6.5%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 70755.50 M AND ELECTRICAL DEMAND IS 24369. KWH/DAY AT 306. KWH/KW
BASED ON INCIDENT INSULATION OF 616. LANG./DAY, HDD/YR OF 4418. CDD/YR OF 1437.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 2.44 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7338. SM	0.120	0.	0.	6121.	100.	734.	0.	20.
BATTERY	113. KWH	0.723	0.	0.	40.	50.	6.	1.	20.
AUX. ELFC	2245. KW	1.000	0.	0.	18565.	0.	0.	212.	20.
BLDG. HT.	74. KW	1.000	19.	19.	10941.	33.	2.	5.	20.
INVERT.	819. KW	0.950	0.	0.	0.	65.	53.	86.	20.
V.C. RFG.	1606. TON	4.500	0.	0.	50779.	477.	765.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	1352. KW	1.000	0.	0.	438.	7.	9.	0.	20.
FP COLL.	28302. SM	0.537	60.	69.	105935.	54.	1523.	0.	20.
HEAT STO	51125. CM	0.700	60.	60.	0.	5.	265.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 26.2% OF LOAD, UTILITY 72.2%, AND FOSSIL FUEL 1.6%

TOTAL CAP. INV. IS \$.33579E+07 WITH YEARLY REC'G. COSTS, .30370E+06

ANNUALIZED COST OF \$.35939E+07 WITH A YEARLY SAVING OF -.48975E+06 DROI= -15.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN BLUE HILL, MASS.

FLOOR AREA IS 70755.50 M AND ELECTRICAL DEMAND IS 23500. KWH/DAY AT 314. KWH/KW

BASED ON INCIDENT INSULATION OF 497. LANG./DAY, HDD/YR OF 6051. CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=12.68 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN	TOUT	ENERGY	INST'D CST.	CAP. INV.	REC'G CST.	CMPL. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE	K\$	YEARS
PV ARRAY	7338. SM	0.126	0.	0.	5222.	100.	734.	0.	20.
BATTERY	81. KWH	0.723	0.	0.	28.	50.	4.	1.	20.
AUX. ELEC	2108. KW	1.000	0.	0.	18546.	0.	0.	312.	20.
BLDG. HT.	74. KW	1.000	19.	19.	11941.	33.	2.	6.	20.
INVERT.	726. KW	0.950	0.	0.	0.	65.	47.	85.	20.
V.C. RFG.	1430. TON	4.500	0.	0.	46867.	499.	713.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	1446. KW	1.000	0.	0.	438.	7.	10.	0.	20.
FP COLL.	28302. SM	0.449	60.	69.	71567.	54.	1523.	0.	20.
HEAT STO	36694. CM	0.700	69.	60.	0.	6.	223.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 22.4% OF LOAD, UTILITY 76.1%, AND FOSSIL FUEL 1.5%

TOTAL CAP. INV. IS \$.32567E+07 WITH YEARLY REC'G. COSTS, .40384E+06

ANNUALIZED COST OF \$.45813E+07 WITH A YEARLY SAVING OF -.32122E+06 DROI= -7.5%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 25812.KWH/DAY AT 307.KWH/KW
BASED ON INCIDENT INSULATION OF 520.LANG./DAY, HDD/YR OF 2371, CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.157 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 3.53 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	2446. SM	0.121	0.	0.	1740.	100.	245.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX. FLEC	2368. KW	1.000	0.	0.	24159.	0.	0.	107.	20.
BLDG. HT.	74. KW	1.000	19.	19.	9706.	33.	2.	2.	20.
INVERT.	237. KW	0.950	0.	0.	0.	65.	15.	82.	20.
V.C. RFG.	1764. TON	4.500	0.	0.	57272.	459.	811.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	1250. KW	1.000	0.	0.	438.	7.	9.	0.	20.
FP COLL.	28302. SM	0.525	60.	69.	87591.	54.	1523.	0.	20.
HEAT STD	51864. CM	0.700	69.	60.	0.	5.	267.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 26.8% OF LOAD, UTILITY 71.6%, AND FOSSIL FUEL 1.7%
TOTAL CAP. INV. IS \$.28716E+07 WITH YEARLY REC'G. COSTS, .19129E+06
ANNUALIZED COST OF \$.23874E+07 WITH A YEARLY SAVING OF -.71946E+06 DROI= -43.1%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 25709.KWH/DAY AT 316.KWH/KW
BASED ON INCIDENT INSULATION OF 485.LANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.26 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7338. SM	0.122	0.	0.	4910.	100.	734.	0.	20.
BATTERY	58. KWH	0.723	0.	0.	13.	50.	3.	1.	20.
AUX. ELEC	2289. KW	1.000	0.	0.	21048.	0.	0.	144.	20.
BLDG. HT.	74. KW	1.000	19.	19.	9025.	33.	2.	1.	20.
INVERT.	662. KW	0.950	0.	0.	0.	65.	43.	84.	20.
V.C. RFG.	1663. TON	4.500	0.	0.	56807.	470.	782.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	1176. KW	1.000	0.	0.	438.	7.	8.	0.	20.
FP COLL.	28302. SM	0.515	60.	69.	80122.	54.	1523.	0.	20.
HEAT STD	40115. CM	0.700	69.	60.	0.	6.	234.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.6% OF LOAD, UTILITY 71.9%, AND FOSSIL FUEL 0.5%
TOTAL CAP. INV. IS \$.33291E+07 WITH YEARLY REC'G. COSTS, .23054E+06
ANNUALIZED COST OF \$.28556E+07 WITH A YEARLY SAVING OF -.68014E+06 DROI= -31.3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 24076.KWH/DAY AT 315.KWH/KW
BASED ON INCIDENT INSOLATION OF 533.LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.040 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 7.96 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7338. SM	0.121	0.	0.	5355.	100.	734.	0.	20.
BATTERY	102. KWH	0.723	0.	0.	32.	50.	5.	1.	20.
AUX.ELEC	2155. KW	1.000	0.	0.	18998.	0.	0.	195.	20.
BLDG.HT.	74. KW	1.000	19.	19.	9023.	33.	2.	1.	20.
INVERT.	756. KW	0.950	0.	0.	0.	65.	49.	85.	20.
V.C.RFG.	1491. TON	4.500	0.	0.	49462.	491.	731.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	1163. KW	1.000	0.	0.	438.	7.	8.	0.	20.
FP COLL.	28302. SM	0.520	60.	69.	88755.	54.	1523.	0.	20.
HEAT STO	50423. CM	0.700	69.	60.	0.	5.	263.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.4% OF LOAD, UTILITY 72.2%, AND FOSSIL FUEL 0.4%
TOTAL CAP. INV. IS \$.33163E+07 WITH YEARLY REC'G. COSTS, .28181E+06
ANNUALIZED COST OF \$.33676E+07 WITH A YEARLY SAVING OF -.51360E+06 DROI= -18.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN MADISON, WIS.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 23482.KWH/DAY AT 312.KWH/KW
BASED ON INCIDENT INSOLATION OF 516.LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.040 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.28 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7338. SM	0.127	0.	0.	5427.	100.	734.	0.	20.
BATTERY	99. KWH	0.723	0.	0.	35.	50.	5.	1.	20.
AUX.ELEC	2120. KW	1.000	0.	0.	18336.	0.	0.	209.	20.
BLDG.HT.	74. KW	1.000	19.	19.	12999.	33.	2.	8.	20.
INVERT.	719. KW	0.950	0.	0.	0.	65.	47.	85.	20.
V.C.RFG.	1446. TON	4.500	0.	0.	46786.	497.	718.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	1540. KW	1.000	0.	0.	438.	7.	10.	0.	20.
FP COLL.	28302. SM	0.447	60.	69.	73951.	54.	1523.	0.	20.
HEAT STO	43616. CM	0.700	69.	60.	0.	6.	244.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 24.6% OF LOAD, UTILITY 72.7%, AND FOSSIL FUEL 2.8%
TOTAL CAP. INV. IS \$.32831E+07 WITH YEARLY REC'G. COSTS, .30337E+06
ANNUALIZED COST OF \$.35783E+07 WITH A YEARLY SAVING OF -.54063E+06 DROI= -17.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN MIAMI, FLA.
FLOOR AREA IS 77755.SQ.M AND ELECTRICAL DEMAND IS 27165.KWH/DAY AT 335.KWH/KW
BASED ON INCIDENT INSULATION OF 525.LANG./DAY, HDD/YR OF 186, CDD/YR OF 3958.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=.159 K=.000 G=.050 GF=.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 6.90 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZF.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7734. SM	0.119	0.	0.	5184.	100.	734.	0.	20.
BATTERY	55. KWH	0.723	0.	0.	8.	50.	3.	1.	20.
AUX. ELEC	2276. KW	1.000	0.	0.	22183.	0.	0.	196.	20.
BLDG. HT.	74. KW	1.000	19.	19.	8581.	33.	2.	0.	20.
INVERT.	647. KW	0.950	0.	0.	0.	65.	45.	85.	20.
V.C. RFG.	1646. TON	4.500	0.	0.	63092.	472.	777.	0.	20.
AH. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD. HTG.	1136. KW	1.000	0.	0.	438.	7.	8.	0.	20.
FP CELL.	28302. SM	0.557	61.	69.	93737.	54.	1523.	0.	20.
HEAT STD	12474. CM	0.700	60.	60.	0.	6.	242.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 25.1% OF LOAD, UTILITY 74.0%, AND FOSSIL FUEL 0.0%
TOTAL CAP. INV. IS \$.33337E+07 WITH YEARLY REC'G. COSTS, .28171E+06
ANNUALIZED COST OF \$.33606E+07 WITH A YEARLY SAVING OF -.57973E+06 DROI= -20.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 77755.SQ.M AND ELECTRICAL DEMAND IS 24770.KWH/DAY AT 308.KWH/KW
BASED ON INCIDENT INSULATION OF 444.LANG./DAY, HDD/YR OF 3632, CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=.159 K=.000 G=.050 GF=.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.04 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZF.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	4402. SM	0.125	0.	0.	3229.	100.	489.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX. ELEC	2268. KW	1.000	0.	0.	21704.	0.	0.	140.	20.
BLDG. HT.	74. KW	1.000	19.	19.	10463.	33.	2.	4.	20.
INVERT.	446. KW	0.950	0.	0.	0.	65.	29.	83.	20.
V.C. RFG.	1636. TON	4.500	0.	0.	52585.	473.	774.	0.	20.
AH. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD. HTG.	1322. KW	1.000	0.	0.	438.	7.	9.	0.	20.
FP CELL.	24302. SM	0.471	61.	69.	70571.	54.	1523.	0.	20.
HEAT STD	36595. CM	0.700	60.	60.	0.	6.	229.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 25.6% OF LOAD, UTILITY 72.4%, AND FOSSIL FUEL 1.9%
TOTAL CAP. INV. IS \$.30560E+07 WITH YEARLY REC'G. COSTS, .22705E+06
ANNUALIZED COST OF \$.27760E+07 WITH A YEARLY SAVING OF -.67479E+06 DROI= -32.1%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN OMAHA, NEB.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 24377.KWH/DAY AT 303.KWH/KW
BASED ON INCIDENT INSOLATION OF 522.1ANG./DAY, HDD/YR OF 5459, CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.040 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 4.95 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE.	KS	YEARS
PV ARRAY	7338. SM	0.124	0.	0.	5376.	100.	734.	0.	20.
BATTERY	84. KWH	0.723	0.	0.	19.	50.	4.	1.	20.
AUX.ELEC	2267. KW	1.000	0.	0.	19275.	0.	0.	125.	20.
BLDG.MT.	74. KW	1.000	19.	19.	11637.	33.	2.	6.	20.
INVERT.	733. KW	0.950	0.	0.	0.	65.	48.	85.	20.
V.C.RFG.	1634. TON	4.500	0.	0.	50813.	473.	774.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	1433. KW	1.000	0.	0.	438.	7.	10.	0.	20.
FP COLL.	28302. SM	0.483	60.	69.	80745.	54.	1523.	0.	20.
HEAT STO	42652. CM	0.700	69.	60.	0.	6.	241.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 32.4% OF LOAD, UTILITY 64.5%, AND FOSSIL FUEL 3.2%

TOTAL CAP. INV. IS \$.33358E+07 WITH YEARLY REC'G. COSTS, .21647E+06

ANNUALIZED COST OF \$.27157E+07 WITH A YEARLY SAVING OF -.61849E+06 DROI= -29.5%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 26569.KWH/DAY AT 308.KWH/KW
BASED ON INCIDENT INSOLATION OF 740.1ANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.040 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 7.19 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE.	KS	YEARS
PV ARRAY	7338. SM	0.109	0.	0.	6690.	100.	734.	0.	20.
BATTERY	139. KWH	0.723	0.	0.	24.	50.	7.	1.	20.
AUX.ELEC	2459. KW	1.000	0.	0.	20219.	0.	0.	192.	20.
BLDG.MT.	74. KW	1.000	19.	19.	9441.	33.	2.	3.	20.
INVERT.	1116. KW	0.950	0.	0.	0.	65.	73.	86.	20.
V.C.RFG.	1880. TON	4.500	0.	0.	60678.	448.	842.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	1191. KW	1.000	0.	0.	438.	7.	8.	0.	20.
FP COLL.	28302. SM	0.623	60.	69.	147647.	54.	1523.	0.	20.
HEAT STO	76272. CM	0.700	69.	60.	0.	4.	326.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 28.1% OF LOAD, UTILITY 70.9%, AND FOSSIL FUEL 1.0%

TOTAL CAP. INV. IS \$.35152E+07 WITH YEARLY REC'G. COSTS, .28190E+06

ANNUALIZED COST OF \$.34010E+07 WITH A YEARLY SAVING OF -.51599E+06 DROI= -17.9%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN SEATTLE, WASH.
 FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 23064.KWH/DAY AT 322.KWH/KW
 BASED ON INCIDENT INSULATION OF 458.LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.060 G=0.150 GF=1.100 H= 20 FUEL= 2.37 \$/GJ, ELECT= 2.02 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	2446. SM	0.128	0.	0.	1617.	100.	245.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX.ELFC	2022. KW	1.000	0.	0.	21548.	0.	0.	55.	20.
BLDG.HT.	74. KW	1.000	19.	19.	11202.	33.	2.	5.	20.
INVERT.	222. KW	0.950	0.	0.	0.	65.	14.	81.	20.
V.C.REF.	1320. TON	4.500	0.	0.	44497.	514.	679.	0.	20.
AB. REF.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD.HTG.	1342. KW	1.000	0.	0.	438.	7.	9.	0.	20.
FP CHLL.	25302. SM	0.424	60.	69.	62197.	54.	1524.	0.	20.
HEAT STD	35729. CM	0.700	69.	60.	0.	6.	220.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 41.4% OF LOAD, UTILITY 54.0%, AND FOSSIL FUEL 4.6%
 TOTAL CAP. INV. IS \$.26032E+07 WITH YEARLY REC'G. COSTS, .14112E+06
 ANNUALIZED COST OF \$.18551E+07 WITH A YEARLY SAVING OF -.69591E+06 DROI= -60.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN WASHINGTON D.C.
 FLOOR AREA IS 70755.SQ.M AND ELECTRICAL DEMAND IS 24264.KWH/DAY AT 311.KWH/KW
 BASED ON INCIDENT INSULATION OF 488.LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1285.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.060 G=0.050 GF=0.100 H= 20 FUEL= 2.37 \$/GJ, ELECT=12.67 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7338. SM	0.125	0.	0.	5072.	100.	734.	0.	20.
BATTERY	76. KWH	0.723	0.	0.	13.	50.	4.	1.	20.
AUX.ELFC	2191. KW	1.000	0.	0.	19390.	0.	0.	330.	20.
BLDG.HT.	74. KW	1.000	19.	19.	10853.	33.	2.	4.	20.
INVERT.	663. KW	0.950	0.	0.	0.	65.	43.	85.	20.
V.C.REF.	1537. TON	4.500	0.	0.	50036.	485.	745.	0.	20.
AB. REF.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD.HTG.	1359. KW	1.000	0.	0.	438.	7.	9.	0.	20.
FP CHLL.	28302. SM	0.468	60.	69.	73306.	54.	1523.	0.	20.
HEAT STD	37327. CM	0.700	69.	60.	0.	6.	225.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.6% OF LOAD, UTILITY 79.2%, AND FOSSIL FUEL 1.0%
 TOTAL CAP. INV. IS \$.32860E+07 WITH YEARLY REC'G. COSTS, .41944E+06
 ANNUALIZED COST OF \$.47425E+07 WITH A YEARLY SAVING OF -.41388E+06 DROI= -9.6%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 12453.50 M AND ELECTRICAL DEMAND IS 9530.0 KWH/DAY AT 283.0 KWH/KW
BASED ON INCIDENT INSULATION OF 616.1 ANO./DAY, HEI/YR OF 1418. CDD/YR OF 1437.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.150 K=0.040 G=0.050 GF=0.10 N=20 FUEL=2.37 \$/GJ, ELECT=8.66 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	24633. SM	0.120	0.	0.	20551.	100.	2463.	0.	20.
BATTERY	242. KWH	0.723	0.	0.	77.	50.	11.	3.	20.
AUX. ELEC	8438. KW	1.000	0.	0.	75798.	0.	0.	819.	20.
BLDG. HT.	290. KW	1.000	19.	19.	80405.	26.	8.	166.	20.
INVERT.	2750. KW	0.950	0.	0.	0.	65.	179.	97.	20.
V.C. REF.	6264. TON	4.500	0.	0.	165347.	280.	1758.	0.	20.
AH. REF.	1. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	8340. KW	1.000	0.	0.	1763.	4.	37.	0.	20.
FP COLL.	21226. SM	0.537	60.	60.	70951.	50.	1142.	0.	20.
HEAT STD	51734. CM	0.700	69.	60.	0.	7.	217.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 20.6% OF LOAD, UTILITY 60.1% AND FOSSIL FUEL 13.4%
TOTAL CAP. INV. IS \$.54070E+17 WITH YEARLY REC'G. COSTS, .10845E+07
ANNUALIZED COST OF \$.11823E+08 WITH A YEARLY SAVING OF .97338E+06 DROI= 7.6%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 42153.50 M AND ELECTRICAL DEMAND IS 9137.0 KWH/DAY AT 290.0 KWH/KW
BASED ON INCIDENT INSULATION OF 497.1 ANO./DAY, HEI/YR OF 6051. CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.150 K=0.040 G=0.050 GF=0.10 N=20 FUEL=2.37 \$/GJ, ELECT=13.10 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	24633. SM	0.126	0.	0.	17531.	100.	2463.	0.	20.
BATTERY	174. KWH	0.723	0.	0.	52.	50.	3.	2.	20.
AUX. ELEC	8207. KW	1.000	0.	0.	74667.	0.	0.	1196.	20.
BLDG. HT.	290. KW	1.000	19.	19.	90697.	26.	8.	200.	20.
INVERT.	2438. KW	0.950	0.	0.	0.	65.	158.	95.	20.
V.C. REF.	5533. TON	4.500	0.	0.	167378.	294.	1628.	0.	20.
AH. REF.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	10158. KW	1.000	0.	0.	1763.	4.	41.	0.	20.
FP COLL.	21226. SM	0.447	60.	60.	53676.	54.	1142.	0.	20.
HEAT STD	21250. CM	0.700	69.	60.	0.	8.	169.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 14.2% OF LOAD, UTILITY 60.1% AND FOSSIL FUEL 16.7%
TOTAL CAP. INV. IS \$.56207E+07 WITH YEARLY REC'G. COSTS, .15821E+07
ANNUALIZED COST OF \$.16781E+08 WITH A YEARLY SAVING OF .90763E+06 DROI= 5.1%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 101926.KWH/DAY AT 284.KWH/KW
BASED ON INCIDENT INSULATION OF 521.1ANG./DAY, HDD/YR OF 2371, CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N=20 FUEL=2.37 \$/GJ, ELECT=2.09 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY KWH/DAY	INST'L'D	CST.	CAP. INV.	REC'G	CMPT. LIFE YEARS
			DEG C	DEG C		\$/UNIT	SIZE	K\$	K\$	
PV ARRAY	9853. SM	0.121	0.	0.	7110.	100.		985.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.		0.	0.	20.
AUX.ELEC	9414. KW	1.000	0.	0.	95266.	0.		0.	324.	20.
HLDG.MT.	209. KW	1.000	19.	19.	57480.	26.		9.	96.	20.
INVERT.	953. KW	0.951	0.	0.	0.	65.		62.	86.	20.
V.C.PFG.	7143. TON	4.500	0.	0.	215164.	268.		1486.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.		0.	0.	20.
PRD.MTG.	6518. KW	1.000	0.	0.	1763.	5.		31.	0.	20.
FP COLL.	21226. SM	0.525	60.	69.	65601.	54.		1142.	0.	20.
HEAT STD	32146. CM	0.710	69.	60.	0.	6.		209.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 23.6% OF LOAD, UTILITY 53.9%, AND FOSSIL FUEL 17.5%

TOTAL CAP. INV. IS \$.43231E+07 WITH YEARLY REC'G. COSTS, .50595E+06

ANNUALIZED COST OF \$.57795E+07 WITH A YEARLY SAVING OF .12011E+06 DROI= 2.0%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 101451.KWH/DAY AT 293.KWH/KW
BASED ON INCIDENT INSULATION OF 485.1ANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N=20 FUEL=2.37 \$/GJ, ELECT=5.32 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY KWH/DAY	INST'L'D	CST.	CAP. INV.	REC'G	CMPT. LIFE YEARS
			DEG C	DEG C		\$/UNIT	SIZE	K\$	K\$	
PV ARRAY	24633. SM	0.122	0.	0.	16483.	100.		2463.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	50.		5.	1.	20.
AUX.ELEC	9041. KW	1.000	0.	0.	85796.	0.		0.	550.	20.
HLDG.MT.	299. KW	1.000	19.	19.	44011.	26.		8.	42.	20.
INVERT.	2221. KW	0.951	0.	0.	0.	65.		144.	94.	20.
V.C.PFG.	6600. TON	4.500	0.	0.	213028.	275.		1813.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.		0.	0.	20.
PRD.MTG.	5209. KW	1.000	0.	0.	1763.	5.		26.	0.	20.
FP COLL.	21226. SM	0.515	60.	69.	60092.	54.		1142.	0.	20.
HEAT STD	23636. CM	0.700	69.	60.	0.	8.		178.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 24.2% OF LOAD, UTILITY 70.4%, AND FOSSIL FUEL 5.4%

TOTAL CAP. INV. IS \$.57797E+07 WITH YEARLY REC'G. COSTS, .68747E+06

ANNUALIZED COST OF \$.78375E+07 WITH A YEARLY SAVING OF .36704E+06 DROI= 4.5%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 93955.KWH/DAY AT 291.KWH/KW
BASED ON INCIDENT INSULATION OF 533.LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 C=0.050 GF=0.100 N=20 FUEL= 2.37 \$/GJ, ELECT= 7.67 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	29560. SM	0.121	0.	0.	21573.	100.	2956.	0.	20.
BATTERY	412. KWH	0.723	0.	0.	129.	50.	21.	4.	20.
AUX. ELEC	8424. KW	1.000	0.	0.	73495.	0.	0.	680.	20.
BLDG. HT.	299. KW	1.000	19.	19.	45699.	26.	8.	52.	20.
INVERT.	5947. KW	0.950	0.	0.	0.	65.	198.	98.	20.
V.C. RFG.	5795. TON	4.500	0.	0.	179295.	289.	1674.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD. HTG.	5013. KW	1.000	1.	0.	1763.	5.	25.	0.	20.
FP COLL.	16981. SM	0.520	61.	69.	53253.	54.	914.	0.	20.
HEAT STO	23492. CM	0.700	64.	60.	0.	8.	178.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 26.3% OF LOAD, UTILITY 68.5%, AND FOSSIL FUEL 5.2%
TOTAL CAP. INV. IS \$.59736E+07 WITH YEARLY REC'G. COSTS, .83451E+06
ANNUALIZED COST OF \$.93435E+07 WITH A YEARLY SAVING OF .95893E+06 DROI= 9.3%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN MADISON, WIS.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 91224.KWH/DAY AT 289.KWH/KW
BASED ON INCIDENT INSULATION OF 516.LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 C=0.050 GF=0.100 N=20 FUEL= 2.37 \$/GJ, ELECT= 8.40 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	24633. SM	0.127	0.	0.	18218.	100.	2463.	0.	20.
BATTERY	237. KWH	0.723	0.	0.	76.	50.	12.	2.	20.
AUX. ELEC	8262. KW	1.000	0.	0.	73938.	0.	0.	784.	20.
BLDG. HT.	299. KW	1.000	19.	19.	119430.	26.	8.	389.	20.
INVERT.	2412. KW	0.950	0.	0.	0.	65.	157.	95.	20.
V.C. RFG.	5573. TON	4.500	0.	0.	167006.	293.	4635.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD. HTG.	11827. KW	1.000	0.	0.	1763.	4.	49.	0.	20.
FP COLL.	21226. SM	0.447	60.	69.	55463.	54.	1142.	0.	20.
HEAT STO	26333. CM	0.700	60.	60.	0.	7.	188.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 10.5% OF LOAD, UTILITY 59.8%, AND FOSSIL FUEL 29.7%
TOTAL CAP. INV. IS \$.56546E+07 WITH YEARLY REC'G. COSTS, .12713E+07
ANNUALIZED COST OF \$.13671E+08 WITH A YEARLY SAVING OF -.18155E+06 DROI= -1.3%

SIES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN MIAMI, FLA.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 107865.KWH/DAY AT 313.KWH/KW
BASED ON INCIDENT INSULATION OF 525.LANG./DAY, HDD/YR OF 186. CDD/YR OF 3958.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.086 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 6.08 \$/GJ(1976 \$)

PHOTOVOLTAIC SIES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE.	K\$	YEARS
PV ARRAY	22560. SM	0.119	0.	0.	20883.	100.	2056.	0.	20.
BATTERY	221. KWH	0.723	0.	0.	27.	50.	11.	2.	20.
AUX.ELEC	8986. KW	1.000	0.	0.	88034.	0.	0.	643.	20.
BLDG.HT.	299. KW	1.000	19.	19.	33319.	26.	8.	5.	20.
INVERT.	2768. KW	0.950	0.	0.	0.	65.	180.	98.	20.
V.C.RFG.	6546. TON	4.500	0.	0.	241891.	276.	1804.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	4709. KW	1.000	0.	0.	1763.	5.	24.	0.	20.
FP COLL.	16981. SM	0.557	60.	69.	56243.	54.	914.	0.	20.
HEAT STU	19039. CM	0.700	69.	60.	0.	8.	159.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 25.9% OF LOAD, UTILITY 73.5%, AND FOSSIL FUEL 0.6%

TOTAL CAP. INV. IS \$.60557E+07 WITH YEARLY REC'G. COSTS, .74868E+06

ANNUALIZED COST OF \$.84963E+07 WITH A YEARLY SAVING OF .64989E+06 DROI= 7.1%

SIES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 97142.KWH/DAY AT 284.KWH/KW
BASED ON INCIDENT INSULATION OF 468.LANG./DAY, HDD/YR OF 3632. CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 4.67 \$/GJ(1976 \$)

PHOTOVOLTAIC SIES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE.	K\$	YEARS
PV ARRAY	9853. SM	0.125	0.	0.	6502.	100.	985.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX.ELEC	8944. KW	1.000	0.	0.	90966.	0.	0.	496.	20.
BLDG.HT.	299. KW	1.000	19.	19.	72034.	26.	8.	181.	20.
INVERT.	897. KW	0.950	0.	0.	0.	65.	58.	86.	20.
V.C.RFG.	6446. TON	4.500	0.	0.	193639.	277.	1787.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	7476. KW	1.000	0.	0.	1763.	5.	36.	0.	20.
FP COLL.	21226. SM	0.471	60.	69.	52929.	54.	1142.	0.	20.
HEAT STU	22531. CM	0.700	69.	60.	0.	8.	174.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 13.6% OF LOAD, UTILITY 63.3%, AND FOSSIL FUEL 23.1%

TOTAL CAP. INV. IS \$.41903E+07 WITH YEARLY REC'G. COSTS, .76210E+06

ANNUALIZED COST OF \$.83260E+07 WITH A YEARLY SAVING OF -.10238E+06 DROI= -1.2%

SIES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN OMAHA, NEB.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 95334.KWH/DAY AT 279.KWH/KW
BASED ON INCIDENT INSULATION OF 522.LANG./DAY, HDD/YR OF 5459, CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 (=0.04) GF=0.100 N=20 FUEL= 2.37 \$/GJ, ELECT= 4.61 \$/GJ(1976 \$)

PHOTOVOLTAIC SIES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	19707. SM	0.124	0.	0.	14438.	100.	1971.	0	20.
BATTERY	33. KWH	0.723	0.	0.	4.	50.	2.	0	20.
AUX.ELFC	4934. KW	1.000	0.	0.	81619.	0.	0.	449.	20.
BLDG.HT.	299. KW	1.000	19.	19.	93347.	26.	8.	257.	20.
INVERT.	1968. KW	0.950	0.	0.	0.	65.	128.	92.	20.
V.C.RFG.	6432. TON	4.500	0.	0.	185502.	277.	1784.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	9878. KW	1.000	0.	0.	1763.	4.	43.	0.	20.
FP COLL.	21226. SM	0.483	60.	69.	60559.	54.	1142.	0.	20.
HEAT STD	25495. CM	0.700	60.	60.	0.	7.	185.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 16.4% OF LOAD, UTILITY 53.2%, AND FOSSIL FUEL 30.4%

TOTAL CAP. INV. IS \$.52628E+07 WITH YEARLY REC'G COSTS, .79974E+06

ANNUALIZED COST OF \$.48687E+07 WITH A YEARLY SAVING OF -30597. DROI= -0.3%

SIES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 105402.KWH/DAY AT 282.KWH/KW
BASED ON INCIDENT INSULATION OF 740.LANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N=20 FUEL= 2.37 \$/GJ, ELECT= 6.34 \$/GJ(1976 \$)

PHOTOVOLTAIC SIES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLATPLATE ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	29560. SM	0.109	0.	0.	26950.	100.	2956.	0.	20.
BATTERY	558. KWH	0.723	0.	0.	106.	50.	28.	6.	20.
AUX.ELFC	9819. KW	1.000	0.	0.	79821.	0.	0.	626.	20.
BLDG.HT.	299. KW	1.000	19.	19.	52808.	26.	8.	66.	20.
INVERT.	4498. KW	0.950	0.	0.	0.	65.	292.	103.	20.
V.C.RFG.	7512. TON	4.500	0.	0.	230809.	261.	1962.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	5292. KW	1.000	0.	0.	1763.	5.	26.	0.	20.
FP COLL.	16981. SM	0.623	60.	69.	88589.	54.	914.	0.	20.
HEAT STD	36205. CM	0.700	60.	60.	0.	6.	222.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.4% OF LOAD, UTILITY 65.3%, AND FOSSIL FUEL 6.9%

TOTAL CAP. INV. IS \$.64077E+07 WITH YEARLY REC'G COSTS, .80042E+06

ANNUALIZED COST OF \$.90726E+07 WITH A YEARLY SAVING OF .94534E+06 DROI= 9.4%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 42453.50.M AND ELECTRICAL DEMAND IS 89398.KWH/DAY AT 299.KWH/KW
BASED ON INCIDENT INSOLATION OF 458.LANG./DAY, HDD/YR OF 5242. CDD/YR OF 254.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=C.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 2.01 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	9853. SM	0.128	0.	0.	6515.	100.	985.	0.	20.
BATTERY	0. KWH	0.723	0.	0.	0.	0.	0.	0.	20.
AUX.ELEC	7812. KW	1.000	0.	0.	83209.	0.	0.	198.	20.
BLDG.HT.	299. KW	1.000	19.	19.	89616.	26.	8.	259.	20.
INVERT.	893. KW	0.950	0.	0.	0.	65.	58.	86.	20.
V.C.RFG.	5105. TON	4.500	0.	0.	158790.	306.	1531.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	8384. KW	1.000	0.	0.	1763.	4.	38.	0.	20.
FP COLL.	21226. SM	0.424	60.	69.	46647.	54.	1142.	0.	20.
HEAT STU	19796. CM	0.700	69.	60.	0.	8.	163.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 14.7% OF LOAD, UTILITY 36.9%, AND FOSSIL FUEL 48.4%

TOTAL CAP. INV. IS \$.39249E+07 WITH YEARLY REC'G. COSTS, .54162E+06

ANNUALIZED COST OF \$.6(720E+07 WITH A YEARLY SAVING OF -.39471E+06 DROI= -7.0%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 42453.50.M AND ELECTRICAL DEMAND IS 94541.KWH/DAY AT 287.KWH/KW
BASED ON INCIDENT INSOLATION OF 488.LANG./DAY, HDD/YR OF 4236. CDD/YR OF 1285.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=C.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=12.82 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A FLATPLATE ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	29560. SM	0.125	0.	0.	20433.	100.	2956.	0.	20.
BATTERY	306. KWH	0.723	0.	0.	51.	50.	15.	3.	20.
AUX.ELEC	8591. KW	1.000	0.	0.	75144.	0.	0.	1211.	20.
BLDG.HT.	299. KW	1.000	19.	19.	79088.	26.	8.	217.	20.
INVERT.	2672. KW	0.950	0.	0.	0.	65.	174.	97.	20.
V.C.RFG.	6032. TON	4.500	0.	0.	181934.	284.	1716.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	8568. KW	1.000	0.	0.	1763.	4.	38.	0.	20.
FP COLL.	16981. SM	0.468	60.	69.	43984.	54.	914.	0.	20.
HEAT STU	15796. CM	0.700	69.	60.	0.	9.	145.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 14.7% OF LOAD, UTILITY 72.3%, AND FOSSIL FUEL 12.9%

TOTAL CAP. INV. IS \$.59655E+07 WITH YEARLY REC'G. COSTS, .15284E+07

ANNUALIZED COST OF \$.16300E+08 WITH A YEARLY SAVING OF .84837E+06 DROI= 4.9%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 18868 SQ.M AND ELECTRICAL DEMAND IS 33402 KWH/DAY AT 285 KWH/KW
BASED ON INCIDENT INSOLATION OF 616 LANG./DAY, HDD/YR OF 4418, CDD/YR OF 1437.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.67 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L'D CST.	CAP. INV.	REC'G CST.	CHRT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE	K\$	YEARS
PV ARRAY	14256 SM	0.120	0	0	11893	100	1426	0	20
BATTERY	1476 KWH	0.723	0	0	1857	50	74	15	20
AUX. ELEC	3100 KW	1.000	0	0	22340	0	0	259	20
BLDG. HT.	144 KW	1.000	19	19	10638	30	4	10	20
INVERT.	1592 KW	0.950	0	0	0	65	103	90	20
V.C. RFG.	1505 TON	4.500	0	0	41710	489	736	0	20
AB. RFG.	0 TON	0.650	0	0	0	0	0	0	20
PRO. HTG.	1522 KW	1.000	0	0	850	7	10	0	20
FP COLL.	7547 SM	0.537	60	69	28249	54	406	0	20
HEAT STD	12838 CM	0.700	69	60	0	10	130	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.5% OF LOAD, UTILITY 69.7%, AND FOSSIL FUEL 2.8%
TOTAL CAP. INV. IS \$.28890E+07 WITH YEARLY REC'G. COSTS, .37439E+06
ANNUALIZED COST OF \$.42260E+07 WITH A YEARLY SAVING OF \$.34538E+06 DROI= 8.9%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 18868 SQ.M AND ELECTRICAL DEMAND IS 32039 KWH/DAY AT 292 KWH/KW
BASED ON INCIDENT INSOLATION OF 497 LANG./DAY, HDD/YR OF 6051, CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=13.04 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L'D CST.	CAP. INV.	REC'G CST.	CHRT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE	K\$	YEARS
PV ARRAY	14256 SM	0.126	0	0	10146	100	1426	0	20
BATTERY	1145 KWH	0.723	0	0	1102	50	57	11	20
AUX. ELEC	2884 KW	1.000	0	0	22571	0	0	381	20
BLDG. HT.	144 KW	1.000	19	19	12665	30	4	17	20
INVERT.	1411 KW	0.950	0	0	0	65	92	89	20
V.C. RFG.	1253 TON	4.500	0	0	35578	525	658	0	20
AB. RFG.	0 TON	0.650	0	0	0	0	0	0	20
PRO. HTG.	1723 KW	1.000	0	0	850	6	11	0	20
FP COLL.	7547 SM	0.449	60	69	19085	54	406	0	20
HEAT STD	8989 CM	0.700	69	60	0	12	108	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 24.3% OF LOAD, UTILITY 72.5%, AND FOSSIL FUEL 3.2%
TOTAL CAP. INV. IS \$.27620E+07 WITH YEARLY REC'G. COSTS, .49817E+06
ANNUALIZED COST OF \$.54463E+07 WITH A YEARLY SAVING OF \$40538 DROI= 0.7%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 35663.KWH/DAY AT 285.KWH/KW
BASED ON INCIDENT INSOLATION OF 520.LANG./DAY, HDD/YR OF 2371, CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELFC= 3.46 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZF.	CAP. INV. KS	REC'G. CST. KS	CHPT. LIFE YEARS
PV ARRAY	4752. SM	0.121	0	0	3381	100	475	0	20
BATTERY	0. KWH	0.723	0	0	0	0	0	0	20
AUX. ELEC	3293. KW	1.000	0	0	32452	0	0	134	20
BLDG. MT.	144. KW	1.000	19	19	8151	30	4	5	20
INVERT.	460. KW	0.950	0	0	0	65	30	83	20
V.C. RFG	1768. TON	4.500	0	0	51885	459	812	0	20
AB. RFG	0. TON	0.650	0	0	0	0	0	0	20
PRO. HTG	1305. KW	1.000	0	0	850	7	9	0	20
FP COLL.	7547. SM	0.525	60	69	23358	54	406	0	20
HEAT STO	13035. CM	0.700	69	60	0	10	131	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.7% OF LOAD, UTILITY 77.5%, AND FOSSIL FUEL 2.9%
TOTAL CAP. INV. IS \$.18671E+07 WITH YEARLY REC'G. COSTS, .22199E+06
ANNUALIZED COST OF \$.25310E+07 WITH A YEARLY SAVING OF -.62820E+06 DROI= -33.0%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 35501.KWH/DAY AT 294.KWH/KW
BASED ON INCIDENT INSOLATION OF 485.LANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELFC= 5.38 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZF.	CAP. INV. KS	REC'G. CST. KS	CHPT. LIFE YEARS
PV ARRAY	7128. SM	0.122	0	0	4770	100	713	0	20
BATTERY	64. KWH	0.723	0	0	17	50	3	1	20
AUX. ELEC	3169. KW	1.000	0	0	30975	0	0	199	20
BLDG. MT.	144. KW	1.000	19	19	6786	30	4	2	20
INVERT.	643. KW	0.950	0	0	0	65	42	84	20
V.C. RFG	1617. TON	4.500	0	0	51156	475	769	0	20
AB. RFG	0. TON	0.650	0	0	0	0	0	0	20
PRO. HTG	1147. KW	1.000	0	0	850	7	8	0	20
FP COLL.	7547. SM	0.515	60	69	21366	54	406	0	20
HEAT STO	9902. CM	0.700	69	60	0	11	114	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 18.0% OF LOAD, UTILITY 81.1%, AND FOSSIL FUEL 0.9%
TOTAL CAP. INV. IS \$.20586E+07 WITH YEARLY REC'G. COSTS, .28588E+06
ANNUALIZED COST OF \$.32028E+07 WITH A YEARLY SAVING OF -.58525E+06 DROI= -22.4%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 18868 SQ.M AND ELECTRICAL DEMAND IS 32943 KWH/DAY AT 293 KWH/KW
BASED ON INCIDENT INSOLATION OF 53% LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N=20 FUEL= 2.37 \$/GJ, ELECT= 8.00 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	14256 SM	0.121	0	0	10404	100	1426	0	20
BATTERY	1411 KWH	0.723	0	0	1285	50	71	14	20
AUX. ELEC	2959 KW	1.000	0	0	23247	0	0	230	20
BLDG. HT.	144 KW	1.000	19	19	6756	30	4	2	20
INVERT.	1470 KW	0.950	0	0	0	65	96	89	20
V.C. RFG.	1347 TON	4.500	0	0	39645	511	686	0	20
AB. RFG.	0 TON	0.650	0	0	0	0	0	0	20
PRO. HTG.	1120 KW	1.000	0	0	850	7	8	0	20
FP COLL.	7547 SM	0.520	60	69	23668	54	406	0	20
HEAT STD	12651 CM	0.700	69	60	0	10	129	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 29.1% OF LOAD, UTILITY 70.2%, AND FOSSIL FUEL 0.6%
TOTAL CAP. INV. IS \$.28252E+07 WITH YEARLY REC'G. COSTS, .33541E+06
ANNUALIZED COST OF \$.38247E+07 WITH A YEARLY SAVING OF .39471E+06 DROI= -11.5%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN MADISON, WI.
FLOOR AREA IS 18868 SQ.M AND ELECTRICAL DEMAND IS 32011 KWH/DAY AT 290 KWH/KW
BASED ON INCIDENT INSOLATION OF 51% LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N=20 FUEL= 2.37 \$/GJ, ELECT= 8.54 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7128 SM	0.127	0	0	5272	100	713	0	20
BATTERY	127 KWH	0.723	0	0	53	50	6	1	20
AUX. ELEC	2903 KW	1.000	0	0	27018	0	0	286	20
BLDG. HT.	144 KW	1.000	19	19	14883	30	4	25	20
INVERT.	698 KW	0.950	0	0	0	65	45	84	20
V.C. RFG.	1266 TON	4.500	0	0	35451	523	662	0	20
AB. RFG.	0 TON	0.650	0	0	0	0	0	0	20
PRO. HTG.	1925 KW	1.000	0	0	850	6	12	0	20
FP COLL.	9434 SM	0.447	60	69	24650	54	508	0	20
HEAT STD	13885 CM	0.700	69	60	0	10	135	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 15.4% OF LOAD, UTILITY 77.7%, AND FOSSIL FUEL 6.9%
TOTAL CAP. INV. IS \$.20861E+07 WITH YEARLY REC'G. COSTS, .39758E+06
ANNUALIZED COST OF \$.43272E+07 WITH A YEARLY SAVING OF .49369E+06 DROI= -12.9%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN MIAMI, FLA.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 37690.KWH/DAY AT 314.KWH/KW
BASED ON INCIDENT INSULATION OF 525.LANG./DAY, HDD/YR OF 186. CDD/YR OF 395A.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, FLECT= 6.79 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZ.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	9504. SM	0.119	0	0	6714	100	950	0	20
BATTERY	286. KWH	0.723	0	0	105	50	14	3	20
AUX.ELEC	3148. KW	1.000	0	0	31328	0	0	254	20
BLDG. HT.	144. KW	1.000	19	19	5965	30	4	0	20
INVERT.	890. KW	0.950	0	0	0	65	58	86	20
V.C.RFG.	1599. TON	4.500	0	0	61006	477	763	0	20
AR. RFG.	0. TON	0.650	0	0	0	0	0	0	20
PRU. HTG.	1046. KW	1.000	0	0	850	7	7	0	20
FP COLL.	7547. SM	0.557	60	69	24997	54	406	0	20
HEAT STD	10637. CM	0.700	69	60	0	11	118	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.6% OF LOAD, UTILITY 80.4%, AND FOSSIL FUEL 0.0%
TOTAL CAP. INV. IS \$.23217E+07 WITH YEARLY REC'G. COSTS, .34302E+06
ANNUALIZED COST OF \$.38187E+07 WITH A YEARLY SAVING OF -.48939E+06 DROI= -14.7%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 34030.KWH/DAY AT 286.KWH/KW
BASED ON INCIDENT INSULATION OF 468.LANG./DAY, HDD/YR OF 3632. CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, FLECT= 5.06 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	FFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZ.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	4752. SM	0.125	0	0	3136	100	475	0	20
BATTERY	0. KWH	0.723	0	0	0	0	0	0	20
AUX.ELEC	3136. KW	1.000	0	0	31052	0	0	186	20
BLDG. HT.	144. KW	1.000	19	19	9678	30	4	10	20
INVERT.	433. KW	0.950	0	0	0	65	28	83	20
V.C.RFG.	1565. TON	4.500	0	0	44539	481	753	0	20
AR. RFG.	0. TON	0.650	0	0	0	0	0	0	20
PRU. HTG.	1459. KW	1.000	0	0	850	7	10	0	20
FP COLL.	7547. SM	0.471	60	69	18819	54	406	0	20
HEAT STD	9496. CM	0.700	69	60	0	12	111	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 16.5% OF LOAD, UTILITY 79.3%, AND FOSSIL FUEL 4.2%
TOTAL CAP. INV. IS \$.17881E+07 WITH YEARLY REC'G. COSTS, .27835E+06
ANNUALIZED COST OF \$.30831E+07 WITH A YEARLY SAVING OF -.57811E+06 DROI= -23.1%

SIES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN OMAHA, NEB.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 33413.KWH/DAY AT 281.KWH/KW
BASED ON INCIDENT INSOLATION OF 522.LANG./DAY, HDD/YR OF 5459. CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUFL= 2.37 \$/GJ, FLECT= 4.95 \$/GJ (1976 \$)

PHOTOVOLTAIC SIES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	FFF	TIN DFG C	TOUT DFG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT 9ZF.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	5940. SM	0.124	0	0	4352	100	594	0	20
BATTERY	23. KWH	0.723	0	0	3	50	1	0	20
AUX. ELEC	3135. KW	1.000	0	0	29280	0	0	172	20
BLDG. HT.	144. KW	1.000	19	19	12053	30	4	13	20
INVERT.	593. KW	0.950	0	0	0	65	39	84	20
V.C. RFG.	1560. TON	4.500	0	0	41763	482	752	0	20
AB. RFG.	0. TON	0.650	0	0	0	0	0	0	20
PRD. HTG.	1697. KW	1.000	0	0	850	6	11	0	20
FP COLL.	9434. SM	0.483	60	69	26915	54	508	0	20
HEAT STD	13568. CM	0.700	69	60	0	10	134	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 21.6% OF LOAD, UTILITY 73.1%, AND FOSSIL FUEL 5.3%
TOTAL CAP. INV. IS \$.20422E+07 WITH YEARLY REC'G. COSTS, .26854E+06
ANNUALIZED COST OF \$.30263E+07 WITH A YEARLY SAVING OF -.51175E+06 PROI= -20.4%

SIES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 36849.KWH/DAY AT 283.KWH/KW
BASED ON INCIDENT INSOLATION OF 740.LANG./DAY, HDD/YR OF 1973. CDD/YR OF 3464.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUFL= 2.37 \$/GJ, FLECT= 7.09 \$/GJ (1976 \$)

PHOTOVOLTAIC SIES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	FFF	TIN DFG C	TOUT DFG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT 9ZF.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	14256. SM	0.109	0	0	12997	100	1426	0	20
BATTERY	2003. KWH	0.723	0	0	2305	50	100	20	20
AUX. FLEC	3435. KW	1.000	0	0	24726	0	0	225	20
BLDG. HT.	144. KW	1.000	19	19	7622	30	4	5	20
INVERT.	2169. KW	0.950	0	0	0	65	141	91	20
V.C. RFG.	1933. TON	4.500	0	0	57224	443	857	0	20
AB. RFG.	0. TON	0.650	0	0	0	0	0	0	20
PRD. HTG.	1178. KW	1.000	0	0	850	7	8	0	20
FP COLL.	7547. SM	0.623	60	69	39373	54	406	0	20
HEAT STD	19233. CM	0.700	69	60	0	8	160	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 30.0% OF LOAD, UTILITY 68.5%, AND FOSSIL FUEL 1.6%
TOTAL CAP. INV. IS \$.31026E+07 WITH YEARLY REC'G. COSTS, .34127E+06
ANNUALIZED COST OF \$.39289E+07 WITH A YEARLY SAVING OF -.45855E+06 PROI= -13.2%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 18868 SQ.M AND ELECTRICAL DEMAND IS 31388 KWH/DAY AT 300 KWH/KW
BASED ON INCIDENT INSULATION OF 458 LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 2.07 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZ.	CAP. INV. K\$	REC'G CST. K\$	CHPT. LIFE YFARS
PV ARRAY	4752. SM	0.128	0	0	3142	100	475	0	20
BATTERY	0. KWH	0.723	0	0	0	0	0	0	20
AUX. ELEC	2750. KW	1.000	0	0	28404	0	0	71	20
BIDG. HT.	144. KW	1.000	19	19	11281	30	4	14	20
INVERT.	431. KW	0.950	0	0	0	65	28	83	20
V.C. RFG	1073. TON	4.500	0	0	32647	558	598	0	20
AB. RFG	0. TON	0.650	0	0	0	0	0	0	20
PRO. HTG.	1501. KW	1.000	0	0	850	7	10	0	20
FP COLL.	7547. SM	0.424	60	69	16586	54	406	0	20
HEAT STD	8655. CM	0.700	69	60	0	12	106	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.9% OF LOAD, UTILITY 60.1%, AND FOSSIL FUEL 12.0%
TOTAL CAP. INV. IS \$.16280E+07 WITH YEARLY REC'G. COSTS, .16785E+06
ANNUALIZED COST OF \$.19491E+07 WITH A YEARLY SAVING OF .64218E+06 DROI= -49.1%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 18868 SQ.M AND ELECTRICAL DEMAND IS 33143 KWH/DAY AT 288 KWH/KW
BASED ON INCIDENT INSULATION OF 488 LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1285.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=13.03 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZ.	CAP. INV. K\$	REC'G CST. K\$	CHPT. LIFE YFARS
PV ARRAY	14256. SM	0.125	0	0	9854	100	1426	0	20
BATTERY	1095. KWH	0.723	0	0	840	50	55	11	20
AUX. ELEC	3016. KW	1.000	0	0	23916	0	0	410	20
BIDG. HT.	144. KW	1.000	19	19	10443	30	4	9	20
INVERT.	1288. KW	0.950	0	0	0	65	84	88	20
V.C. RFG	1423. TON	4.500	0	0	40545	500	711	0	20
AB. RFG	0. TON	0.650	0	0	0	0	0	0	20
PRO. HTG.	1538. KW	1.000	0	0	850	7	10	0	20
FP COLL.	7547. SM	0.468	60	69	19548	54	406	0	20
HEAT STD	9158. CM	0.700	69	60	0	12	109	0	20

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 21.4% OF LOAD, UTILITY 76.9%, AND FOSSIL FUEL 1.8%
TOTAL CAP. INV. IS \$.28049E+07 WITH YEARLY REC'G. COSTS, .51874E+06
ANNUALIZED COST OF \$.56596E+07 WITH A YEARLY SAVING OF .16416E+06 DROI= -3.0%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 14868.SQ.M AND ELECTRICAL DEMAND IS 26855.KWH/DAY AT 169.KWH/KW
BASED ON INCIDENT INSULATION OF 616.LANG./DAY, HDD/YR OF 4418, CDD/YR OF 1437.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.950 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=15.26 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	6173. SM	0.120	0.	0.	5150.	100.	617.	0.	20.
BATTERY	216. KWH	0.723	0.	0.	116.	50.	11.	2.	20.
AUX. ELEC	2863. KW	1.000	0.	0.	21994.	0.	6.	218.	20.
BLDG. HT.	75. KW	1.000	19.	19.	29429.	33.	2.	42.	20.
INVERT.	690. KW	0.950	0.	0.	0.	65.	45.	84.	20.
V.C. REG.	2542. TON	4.511	0.	0.	78100.	395.	1025.	0.	20.
AB. REG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	3260. KW	1.000	0.	0.	593.	6.	18.	0.	20.
FP COLL.	9434. SM	0.537	60.	69.	35312.	54.	508.	0.	20.
HEAT STD	12641. CM	0.700	69.	60.	0.	10.	129.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 23.2% OF LOAD, UTILITY 64.4%, AND FOSSIL FUEL 12.4%

TOTAL CAP. INV. IS \$.23551E+07 WITH YEARLY REC'G. COSTS, .34579E+06

ANNUALIZED COST OF \$.38520E+07 WITH A YEARLY SAVING OF -.24521E+06 DRUJ= -6.8%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 14869.SQ.M AND ELECTRICAL DEMAND IS 26153.KWH/DAY AT 191.KWH/KW
BASED ON INCIDENT INSULATION OF 497.LANG./DAY, HDD/YR OF 6051, CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2016 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.950 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=15.22 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A FLAT ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	6173. SM	0.126	0.	0.	4393.	100.	617.	0.	20.
BATTERY	188. KWH	0.723	0.	0.	104.	50.	9.	2.	20.
AUX. ELEC	2773. KW	1.000	0.	0.	22008.	0.	0.	322.	20.
BLDG. HT.	75. KW	1.000	19.	19.	35869.	33.	2.	77.	20.
INVERT.	611. KW	0.950	0.	0.	0.	65.	40.	83.	20.
V.C. REG.	2441. TON	4.500	0.	0.	74940.	405.	988.	0.	20.
AB. REG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	3650. KW	1.000	0.	0.	593.	5.	20.	0.	20.
FP COLL.	9434. SM	0.449	60.	69.	23856.	54.	508.	0.	20.
HEAT STD	8048. CM	0.700	69.	60.	0.	13.	102.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 15.3% OF LOAD, UTILITY 68.3%, AND FOSSIL FUEL 16.4%

TOTAL CAP. INV. IS \$.22868E+07 WITH YEARLY REC'G. COSTS, .48404E+06

ANNUALIZED COST OF \$.52269E+07 WITH A YEARLY SAVING OF -.29741E+06 DRUJ= -6.0%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 18888.30 M AND ELECTRICAL DEMAND IS 28020. KWH/DAY AT 101. KWH/KW
BASED ON INCIDENT INSULATION OF 520. LANG./DAY, HDD/YR OF 2371. CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.081 C=0.650 GE=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 4.28 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	2467. SM	0.121	0.	0.	1757.	100.	247.	0.	20.
BATTERY	69. KWH	0.723	0.	0.	26.	50.	3.	1.	20.
AUX. ELEC	3061. KW	1.000	0.	0.	26359.	0.	0.	106.	20.
BLDG. HT.	75. KW	1.000	19.	19.	21369.	33.	2.	26.	20.
INVERT.	239. KW	0.950	0.	0.	0.	65.	16.	81.	20.
V.C. RFG.	2714. TON	4.500	0.	0.	83343.	388.	1054.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD. HTG.	2615. KW	1.000	0.	0.	593.	6.	15.	0.	20.
FP COLL.	9434. SM	0.525	60.	69.	29197.	54.	508.	0.	20.
HEAT STD	12924. CM	0.700	69.	60.	0.	10.	130.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 23.9% OF LOAD, UTILITY 61.1%, AND FOSSIL FUEL 15.0%
TOTAL CAP. INV. IS \$.19753E+07 WITH YEARLY REC'G. COSTS, .21418E+06
ANNUALIZED COST OF \$.24703E+07 WITH A YEARLY SAVING OF -.51100E+06 DRUI= -26.1%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 18888.30 M AND ELECTRICAL DEMAND IS 27937. KWH/DAY AT 194. KWH/KW
BASED ON INCIDENT INSULATION OF 485. LANG./DAY, HDD/YR OF 1211. CDD/YR OF 2671.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
FCR=0.159 K=0.080 C=0.650 GE=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 6.21 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7407. SM	0.122	0.	0.	4957.	100.	741.	0.	20.
BATTERY	203. KWH	0.723	0.	0.	86.	50.	10.	2.	20.
AUX. ELEC	2898. KW	1.000	0.	0.	23251.	0.	0.	139.	20.
BLDG. HT.	75. KW	1.000	19.	19.	16794.	33.	2.	16.	20.
INVERT.	668. KW	0.950	0.	0.	0.	65.	43.	83.	20.
V.C. RFG.	2629. TON	4.500	0.	0.	82968.	393.	1034.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD. HTG.	2105. KW	1.000	0.	0.	593.	6.	13.	0.	20.
FP COLL.	7547. SM	0.515	60.	69.	21366.	54.	406.	0.	20.
HEAT STD	6328. CM	0.700	69.	60.	0.	14.	90.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 25.9% OF LOAD, UTILITY 66.2%, AND FOSSIL FUEL 7.9%
TOTAL CAP. INV. IS \$.23401E+07 WITH YEARLY REC'G. COSTS, .24077E+06
ANNUALIZED COST OF \$.27966E+07 WITH A YEARLY SAVING OF -.48117E+06 DRUI= -20.8%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 18868.80.M AND ELECTRICAL DEMAND IS 26619.KWH/DAY AT 192.KWH/KW
BASED ON INCIDENT INSULATION OF 533.LANG./DAY, HDD/YR OF 1441. CDD/YR OF 1168.

ASSUMPTIONS:

FOR A 2006START UP OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 8.85 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	7407. SM	0.121	0.	0.	5406.	100.	741.	0.	20.
BATTERY	248. KWH	0.723	0.	0.	131.	50.	12.	2.	20.
AUX.ELEC	2759. KW	1.000	0.	0.	21518.	0.	0.	182.	20.
BLDG.MT.	75. KW	1.000	19.	19.	17693.	33.	2.	19.	20.
INVERT.	764. KW	0.950	0.	0.	0.	65.	50.	84.	20.
V.C.RFG.	2497. TON	4.500	0.	0.	77036.	402.	1001.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	2000. KW	1.000	0.	0.	593.	6.	12.	0.	20.
FP COLL.	7547. SM	0.520	60.	69.	23668.	54.	406.	0.	20.
HEAT STD	8978. CM	0.700	69.	60.	0.	12.	108.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 25.7% OF LOAD, UTILITY 67.4%, AND FOSSIL FUEL 6.9%

TOTAL CAP.INV. IS \$.23326E+07 WITH YEARLY REC'G.COSTS, .28632E+06

ANNUALIZED COST OF \$.32521E+07 WITH A YEARLY SAVING OF -.34698E+06 DROI= -11.9%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN MADISON, WIS.
FLOOR AREA IS 18868.80.M AND ELECTRICAL DEMAND IS 26138.KWH/DAY AT 190.KWH/KW
BASED ON INCIDENT INSULATION OF 516.LANG./DAY, HDD/YR OF 7737. CDD/YR OF 620.

ASSUMPTIONS:

FOR A 2006START UP OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=10.58 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	6173. SM	0.127	0.	0.	4565.	100.	617.	0.	20.
BATTERY	204. KWH	0.723	0.	0.	111.	50.	10.	2.	20.
AUX.ELEC	2773. KW	1.000	0.	0.	21832.	0.	0.	227.	20.
BLDG.MT.	75. KW	1.000	19.	19.	42524.	33.	2.	103.	20.
INVERT.	605. KW	0.950	0.	0.	0.	65.	39.	83.	20.
V.C.RFG.	2457. TON	4.500	0.	0.	74875.	404.	992.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.MTG.	4280. KW	1.000	0.	0.	593.	5.	22.	0.	20.
FP COLL.	9430. SM	0.447	60.	69.	24650.	54.	508.	0.	20.
HEAT STD	10234. CM	0.700	69.	60.	0.	11.	116.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 13.0% OF LOAD, UTILITY 59.8%, AND FOSSIL FUEL 27.2%

TOTAL CAP.INV. IS \$.23072E+07 WITH YEARLY REC'G.COSTS, .41470E+06

ANNUALIZED COST OF \$.45350E+07 WITH A YEARLY SAVING OF -.53029E+06 DROI= -13.2%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN MIAMI, FLA.
FLOOR AREA IS 10000.00 M AND ELECTRICAL DEMAND IS 20005.0 KWH/DAY AT 203.0 KWH/KW
BASED ON INCIDENT INSULATION OF 525.0 KJ/M²/DAY, HDD/YR OF 186.0 CDD/YR OF 395H.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.150 K=\$, DRG G=0.050 GF=0.100 N=20 FUEL=2.37 \$/GJ, ELECT=7.65 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	7407. SM	0.119	0.	0.	5233.	100.	741.	0.	20.
BATTERY	21. KWH	0.723	0.	0.	63.	50.	10.	2.	20.
AUX. FUEL	2400. KW	1.000	0.	0.	24111.	0.	0.	176.	20.
BLDG. HT.	75. KW	1.000	19.	19.	12766.	33.	2.	4.	20.
INVERT.	624. KW	0.950	0.	0.	0.	65.	45.	84.	20.
V.C. REG.	2613. TON	4.500	0.	0.	8043.	394.	1030.	0.	20.
AB. REG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	1340. KW	1.000	0.	0.	593.	7.	9.	0.	20.
FP COLL.	7547. SM	0.557	60.	60.	24997.	54.	406.	0.	20.
HEAT STD	7114. CM	0.730	69.	60.	0.	14.	95.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 25.7% OF LOAD, UTILITY 72.6%, AND FOSSIL FUEL 1.6%
TOTAL CAP. INV. IS \$.23390E+07 WITH YEARLY REC'G. COSTS, .26587E+06
ANNUALIZED COST OF \$.30481E+07 WITH A YEARLY SAVING OF -.40332E+06 DROI= -15.2%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 18668.30 M AND ELECTRICAL DEMAND IS 27179.0 KWH/DAY AT 190.0 KWH/KW
BASED ON INCIDENT INSULATION OF 468.0 KJ/M²/DAY, HDD/YR OF 3632.0 CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.150 K=\$, DRG G=0.050 GF=0.100 N=20 FUEL=2.37 \$/GJ, ELECT=5.99 \$/GJ (1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
PV ARRAY	2469. SM	0.125	0.	0.	1629.	100.	247.	0.	20.
BATTERY	70. KWH	0.723	0.	0.	25.	50.	4.	1.	20.
AUX. FUEL	2988. KW	1.000	0.	0.	25639.	0.	0.	143.	20.
BLDG. HT.	75. KW	1.000	19.	19.	26327.	33.	2.	50.	20.
INVERT.	225. KW	0.950	0.	0.	0.	65.	15.	81.	20.
V.C. REG.	2611. TON	4.500	0.	0.	79558.	394.	1030.	0.	20.
AB. REG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO. HTG.	2960. KW	1.000	0.	0.	593.	6.	17.	0.	20.
FP COLL.	9434. SM	0.471	60.	60.	23524.	54.	508.	0.	20.
HEAT STD	8560. CM	0.700	69.	60.	0.	12.	106.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 14.9% OF LOAD, UTILITY 63.1%, AND FOSSIL FUEL 22.1%
TOTAL CAP. INV. IS \$.19271E+07 WITH YEARLY REC'G. COSTS, .27543E+06
ANNUALIZED COST OF \$.30766E+07 WITH A YEARLY SAVING OF -.58433E+06 DROI= -23.4%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN OMAHA, NEB.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 26861.KWH/DAY AT 188.KWH/KW
BASED ON INCIDENT INSULATION OF 522.LANG./DAY, HDD/YR OF 5459. CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.60 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT SZE.	K\$	K\$	YEARS
PV ARRAY	6173. SM	0.124	0.	0.	4523.	100.	617.	0.	20.
BATTERY	191. KWH	0.723	0.	0.	94.	50.	10.	2.	20.
AUX.ELEC	2902. KW	1.000	0.	0.	22590.	0.	0.	121.	20.
BLDG.HT.	75. KW	1.000	19.	19.	33536.	33.	2.	70.	20.
INVERT.	616. KW	0.950	0.	0.	0.	65.	40.	83.	20.
V.C.RFG.	2611. TON	4.500	0.	0.	78127.	394.	1029.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	3665. KW	1.000	0.	0.	593.	5.	20.	0.	20.
FP COLL.	9434. SM	0.483	60.	60.	26915.	54.	508.	0.	20.
HEAT STD	9868. CM	0.700	69.	60.	0.	12.	114.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.5% OF LOAD, UTILITY 51.1%, AND FOSSIL FUEL 29.4%

TOTAL CAP. INV. IS \$.23399E+07 WITH YEARLY REC'G. COSTS, .27585E+06

ANNUALIZED COST OF \$.31483E+07 WITH A YEARLY SAVING OF -.55793E+06 DROI= -21.5%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN PHOENIX, ARIZ.

FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 28632.KWH/DAY AT 190.KWH/KW

BASED ON INCIDENT INSULATION OF 740.LANG./DAY, HDD/YR OF 1973. CDD/YR OF 3464.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.04 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT SZE.	K\$	K\$	YEARS
PV ARRAY	7407. SM	0.109	0.	0.	6753.	100.	741.	0.	20.
BATTERY	285. KWH	0.723	0.	0.	103.	50.	14.	3.	20.
AUX.ELEC	3016. KW	1.000	0.	0.	22244.	0.	0.	175.	20.
BLDG.HT.	75. KW	1.000	19.	19.	19800.	33.	2.	22.	20.
INVERT.	1127. KW	0.950	0.	0.	0.	65.	73.	85.	20.
V.C.RFG.	2814. TON	4.500	0.	0.	86094.	383.	1078.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRO.HTG.	2495. KW	1.000	0.	0.	593.	6.	15.	0.	20.
FP COLL.	7547. SM	0.623	60.	60.	39373.	54.	406.	0.	20.
HEAT STD	15773. CM	0.700	69.	60.	0.	9.	145.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.3% OF LOAD, UTILITY 64.7%, AND FOSSIL FUEL 8.0%

TOTAL CAP. INV. IS \$.24737E+07 WITH YEARLY REC'G. COSTS, .28413E+06

ANNUALIZED COST OF \$.32532E+07 WITH A YEARLY SAVING OF -.32070E+06 DROI= -10.9%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 25817.KWH/DAY AT 193.KWH/KW
BASED ON INCIDENT INSULATION OF 456.LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 2.66 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	2469. SM	0.128	0.	0.	1633.	100.	247.	0.	20.
BATTERY	75. KWH	0.723	0.	0.	41.	50.	4.	1.	20.
AUX.ELEC	2785. KW	1.000	0.	0.	24278.	0.	0.	61.	20.
BLDG.HT.	75. KW	1.000	19.	19.	32666.	33.	2.	68.	20.
INVERT.	224. KW	0.950	0.	0.	-0.	65.	15.	81.	20.
V.C.RFG.	2355. TON	4.500	0.	0.	73430.	410.	967.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD.HTG.	2870. KW	1.000	0.	0.	593.	6.	16.	0.	20.
FP COLL.	9434. SM	0.424	60.	69.	20732.	54.	508.	0.	20.
HEAT STD	7698. CM	0.700	69.	60.	0.	13.	100.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.1% OF LOAD,UTILITY 38.1%,AND FOSSIL FUEL 42.8%

TOTAL CAP.INV. IS \$.18584E+07 WITH YEARLY REC'G.COSTS, .21102E+06

ANNUALIZED COST OF \$.24195E+07 WITH A YEARLY SAVING OF -.62048E+06 DROI= -34.5%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG. LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 18868.SQ.M AND ELECTRICAL DEMAND IS 26722.KWH/DAY AT 191.KWH/KW
BASED ON INCIDENT INSULATION OF 488.LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1285.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=15.66 \$/GJ(1976 \$)

PHOTOVOLTAIC STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A PHOTOVOLTAIC ARRAY

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SZE.	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
PV ARRAY	7407. SM	0.125	0.	0.	5120.	100.	741.	0.	20.
BATTERY	222. KWH	0.723	0.	0.	109.	50.	11.	2.	20.
AUX.ELEC	2817. KW	1.000	0.	0.	21887.	0.	0.	336.	20.
BLDG.HT.	75. KW	1.000	19.	19.	28709.	33.	2.	60.	20.
INVERT.	669. KW	0.950	0.	0.	-0.	65.	44.	83.	20.
V.C.RFG.	2527. TON	4.500	0.	0.	77500.	399.	1009.	0.	20.
AB. RFG.	0. TON	0.650	0.	0.	0.	0.	0.	0.	20.
PRD.HTG.	3155. KW	1.000	0.	0.	593.	6.	18.	0.	20.
FP COLL.	7547. SM	0.468	60.	69.	19548.	54.	406.	0.	20.
HEAT STD	5763. CM	0.700	69.	60.	0.	15.	86.	0.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 15.6% OF LOAD,UTILITY 71.6%,AND FOSSIL FUEL 12.8%

TOTAL CAP.INV. IS \$.23169E+07 WITH YEARLY REC'G.COSTS, .48181E+06

ANNUALIZED COST OF \$.52095E+07 WITH A YEARLY SAVING OF -.29719E+06 DROI= -6.0%

3.2 RANKINE CYCLE THERMAL STES CONFIGURATIONS

Pages 76 to 81 show the STES configurations selected for the large shopping center located in the 12 sites which are in alphabetical order by city name.

Pages 82 to 87 show the STES configurations selected for an energy conserving large shopping center retrofit for the 12 site locations.

Pages 88 to 93 show the STES configurations selected for a large shopping center constructed to the new standard (ASHRAE 90-75) located at the 12 site locations.

Pages 94 to 99 show the STES configurations selected for a medium shopping center located at the 12 sites.

Pages 100 to 105 show the STES configuration selected for a large retail store located at the 12 sites.

Pages 106 to 111 show the STES configuration selected for a low rise office building that is located at the 12 sites.

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 141099, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 698, LANG./DAY, HDD/YR OF 4418, CDD/YR OF 1437,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.40 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161, SM	0.379	233.	321.	42386.	100.	1416.	76.	20.
BATTSTO.	1152, KWH	0.723	0.	0.	218.	78.	90.	20.	20.
HEAT EX.	16015, SM	0.941	321.	233.	449639.	14.	220.	0.	20.
AUX. HTG.	67325, KW	0.750	228.	371.	543008.	3.	190.	1566.	20.
PCS	10229, KW	0.203	371.	110.	91091.	330.	3380.	492.	20.
V.C. RFG.	7041, TON	4.500	0.	0.	110618.	268.	1886.	0.	20.
AB. RFG.	5667, TON	0.698	108.	8.	183392.	329.	1866.	0.	20.
PRO. HTG.	8256, KW	1.000	110.	19.	0.	12.	97.	0.	20.
COOL TWR	8168, SM	0.700	110.	108.	95655.	5.	37.	0.	20.
COLD STO	719, CM	0.700	8.	17.	0.	91.	66.	0.	20.
AUX. ELEC	2463, KW	0.0	0.	0.	9010.	0.	0.	142.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES =0.8% OF LOAD, UTILITY 8.4%, AND FOSSIL FUEL 92.4%
TOTAL CAP. INV. IS \$.92461E+07 WITH YEARLY REC'G. COSTS, .22970E+07
ANNUALIZED COST OF \$.24542E+08 WITH A YEARLY SAVING OF -.70786E+07 DRUI= -40.5%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 136065, KWH/DAY AT 314, KWH/KW
BASED ON INCIDENT INSOLATION OF 472, LANG./DAY, HDD/YR OF 6051, CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=12.73 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	10621, SM	0.245	233.	321.	13928.	100.	1062.	57.	20.
BATTSTO.	0, KWH	0.723	0.	0.	0.	0.	0.	1.	20.
HEAT EX.	13507, SM	0.941	321.	233.	429120.	15.	198.	0.	20.
AUX. HTG.	56781, KW	0.750	228.	371.	553594.	3.	179.	1597.	20.
PCS	8627, KW	0.203	371.	110.	86934.	350.	3021.	481.	20.
V.C. RFG.	5722, TON	4.500	0.	0.	86031.	290.	1662.	0.	20.
AB. RFG.	5796, TON	0.717	108.	8.	185326.	327.	1895.	0.	20.
PRO. HTG.	8801, KW	1.000	110.	19.	0.	11.	99.	0.	20.
COOL TWR	6221, SM	0.700	110.	108.	83611.	5.	31.	0.	20.
COLD STO	166, CM	0.700	8.	17.	0.	186.	31.	0.	20.
AUX. ELEC	929, KW	0.0	0.	0.	7883.	0.	0.	134.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 27.4% OF LOAD, UTILITY 5.6%, AND FOSSIL FUEL 67.0%
TOTAL CAP. INV. IS \$.81782E+07 WITH YEARLY REC'G. COSTS, .22704E+07
ANNUALIZED COST OF \$.24101E+08 WITH A YEARLY SAVING OF .23858E+06 DRUI= 1.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 149455, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 515, LANG./DAY, HDD/YR OF 2371, CDD/YR OF 2766,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 2.60 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161, SM	0.333	206.	321.	27513.	100.	1416.	76.	20.
BATTSTU.	432, KWH	0.723	0.	0.	50.	96.	41.	10.	20.
HEAT EX.	13106, SM	0.954	321.	206.	397568.	15.	195.	0.	20.
AUX. HTG.	55098, KW	0.750	200.	371.	493414.	3.	178.	1423.	20.
PCS	9975, KW	0.241	371.	60.	95965.	333.	3324.	504.	20.
V.C. RFG.	10214, TON	4.500	0.	0.	331603.	232.	2366.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO. HTG.	7668, KW	1.000	60.	19.	0.	12.	95.	0.	20.
COOL TWR	33149, SM	0.700	60.	105.	242477.	3.	85.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. FLEC	5101, KW	0.0	0.	0.	53501.	0.	0.	205.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES***** OF LOAD, UTILITY 29.3%, AND FOSSIL FUEL 203.5%

TOTAL CAP. INV. IS \$,77001E+07 WITH YEARLY REC'G. COSTS, ,22186E+07

ANNUALIZED COST OF \$,23503E+08 WITH A YEARLY SAVING OF -,15995E+08 DRUI= -213.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 148854, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 448, LANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.16 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161, SM	0.289	206.	321.	20707.	100.	1416.	76.	20.
BATTSTU.	20, KWH	0.723	0.	0.	2.	95.	2.	1.	20.
HEAT EX.	12533, SM	0.954	321.	206.	384774.	15.	190.	0.	20.
AUX. HTG.	52690, KW	0.750	200.	371.	485426.	3.	175.	1400.	20.
PCS	9539, KW	0.241	371.	60.	92876.	338.	3228.	496.	20.
V.C. RFG.	9626, TON	4.500	0.	0.	328909.	237.	2282.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO. HTG.	7238, KW	1.000	60.	19.	0.	13.	93.	0.	20.
COOL TWR	27633, SM	0.700	60.	105.	237108.	3.	77.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. ELEC	5101, KW	0.0	0.	0.	55979.	0.	0.	358.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=53.5% OF LOAD, UTILITY 31.3%, AND FOSSIL FUEL 122.3%

TOTAL CAP. INV. IS \$,74620E+07 WITH YEARLY REC'G. COSTS, ,23325E+07

ANNUALIZED COST OF \$,24606E+08 WITH A YEARLY SAVING OF -,12644E+08 DRUI= -105.7%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN LOS ANGELES, CA,
FLOOR AREA IS 70755,SQ.M AND ELECTRICAL DEMAND IS 139403,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 541,LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 7.41 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161, SM	0.391	181.	205.	33915.	100.	1416.	76.	20.
BATTSTN.	719, KWH	0.723	0.	0.	132.	95.	69.	14.	20.
HEAT EX.	14819, SM	0.811	205.	181.	414537.	14.	210.	0.	20.
AUX.HTG.	62297, KW	0.750	175.	255.	507494.	3.	185.	1464.	20.
PCS	6394, KW	0.137	255.	110.	56726.	388.	2479.	392.	20.
V.C.RFG.	3927, TON	4.500	0.	0.	20748.	336.	1321.	0.	20.
AB. RFG.	8183, TON	0.805	108.	8.	265632.	295.	2413.	0.	20.
PRO.HTG.	7166, KW	1.000	110.	19.	0.	13.	93.	0.	20.
COOL TWR	6957, SM	0.700	110.	108.	27824.	5.	33.	0.	20.
COLD STO	1723, CM	0.700	8.	17.	0.	60.	103.	0.	20.
AUX.ELEC	2868, KW	0.0	0.	0.	22721.	0.	0.	236.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=15.9% OF LOAD,UTILITY 16.1%,AND FOSSIL FUEL 99.8%

TOTAL CAP. INV. IS \$,83203E+07 WITH YEARLY REC'G.COSTS, ,21827E+07

ANNUALIZED COST OF \$,23244E+08 WITH A YEARLY SAVING OF =,80812E+07 DROI= -53.3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN MADISON, WIS,
FLOOR AREA IS 70755,SQ.M AND ELECTRICAL DEMAND IS 135960,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 516,LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 8.02 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161, SM	0.317	181.	205.	26227.	100.	1416.	76.	20.
BATTSTN.	1329, KWH	0.723	0.	0.	276.	85.	114.	23.	20.
HEAT EX.	14006, SM	0.811	205.	181.	419849.	14.	203.	0.	20.
AUX.HTG.	58883, KW	0.750	175.	255.	524827.	3.	182.	1514.	20.
PCS	6043, KW	0.137	255.	110.	57453.	395.	2388.	395.	20.
V.C.RFG.	3478, TON	4.500	0.	0.	20348.	353.	1226.	0.	20.
AB. RFG.	8156, TON	0.747	108.	8.	250540.	295.	2407.	0.	20.
PRO.HTG.	9346, KW	1.000	110.	19.	0.	11.	101.	0.	20.
COOL TWR	6059, SM	0.700	110.	108.	27183.	5.	31.	0.	20.
COLD STO	2131, CM	0.700	8.	17.	0.	54.	115.	0.	20.
AUX.ELEC	2868, KW	0.0	0.	0.	21969.	0.	0.	265.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES =9.5% OF LOAD,UTILITY 16.3%,AND FOSSIL FUEL 93.1%

TOTAL CAP. INV. IS \$,81821E+07 WITH YEARLY REC'G.COSTS, ,22732E+07

ANNUALIZED COST OF \$,24129E+08 WITH A YEARLY SAVING OF =,73866E+07 DROI= -44.1%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN MIAMI, FLA.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 156941, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 524, LANG./DAY, HDD/YR OF 186, CDD/YR OF 3958.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 5,75 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161, SM	0,326	206,	321,	27405,	100,	1416,	76,	20,
BATTSTO.	0, KWH	0,723	0,	0,	0,	0,	0,	1,	20,
HEAT EX.	12463, SM	0,954	321,	206,	419804,	15,	189,	0,	20,
AUX. HTG.	52394, KW	0,750	200,	371,	523204,	3,	175,	1509,	20,
PCS	9485, KW	0,241	371,	60,	101332,	339,	3216,	518,	20,
V.C. RFG.	9529, TON	4,500	0,	0,	365297,	238,	2268,	0,	20,
AB. RFG.	0, TON	0,0	105,	8,	0,	0,	0,	0,	20,
PRO. HTG.	7005, KW	1,000	60,	19,	0,	13,	92,	0,	20,
COOL TWR	26877, SM	0,700	60,	105,	266255,	3,	75,	0,	20,
COLD STO	0, CM	0,700	8,	17,	0,	0,	0,	0,	20,
AUX. ELEC	5101, KW	0,0	0,	0,	55609,	0,	0,	439,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=50,1% OF LOAD, UTILITY 33,9%, AND FOSSIL FUEL 116,3%

TOTAL CAP. INV. IS \$,74307E+07 WITH YEARLY REC'G. COSTS, ,25438E+07

ANNUALIZED COST OF \$,26719E+08 WITH A YEARLY SAVING OF =,13228E+08 DROI= -98,0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 143422, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 415, LANG./DAY, HDD/YR OF 3632, CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 4,39 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SZE.	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161, SM	0,282	206,	321,	18726,	100,	1416,	76,	20,
BATTSTO.	0, KWH	0,723	0,	0,	0,	0,	0,	1,	20,
HEAT EX.	12334, SM	0,954	321,	206,	371119,	15,	188,	0,	20,
AUX. HTG.	51853, KW	0,750	200,	371,	469861,	3,	174,	1355,	20,
PCS	9387, KW	0,241	371,	60,	89580,	340,	3194,	488,	20,
V.C. RFG.	9471, TON	4,500	0,	0,	304465,	239,	2259,	0,	20,
AB. RFG.	0, TON	0,0	105,	8,	0,	0,	0,	0,	20,
PRO. HTG.	8084, KW	1,000	60,	19,	0,	12,	96,	0,	20,
COOL TWR	26446, SM	0,700	60,	105,	218425,	3,	75,	0,	20,
COLD STO	0, CM	0,700	8,	17,	0,	0,	0,	0,	20,
AUX. ELEC	5168, KW	0,0	0,	0,	53842,	0,	0,	315,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=65,7% OF LOAD, UTILITY 31,3%, AND FOSSIL FUEL 134,4%

TOTAL CAP. INV. IS \$,74022E+07 WITH YEARLY REC'G. COSTS, ,22359E+07

ANNUALIZED COST OF \$,23628E+08 WITH A YEARLY SAVING OF =,13042E+08 DROI= -123,2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 153836, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 904, LANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 5,96 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY KWH/DAY	INST'D CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
			DEG C	DEG C					
COLLECT.	14161, SM	0,290	206,	321,	42046,	100,	1416,	76,	20,
BATTSTO.	1221, KWH	0,723	0,	0,	240,	78,	96,	22,	20,
HEAT EX.	13713, SM	0,954	321,	206,	436533,	15,	200,	0,	20,
AUX.HTG.	57648, KW	0,750	200,	371,	525989,	3,	180,	1517,	20,
PCS	10784, KW	0,241	371,	60,	105370,	325,	3500,	527,	20,
V.C.RFG.	10882, TON	4,500	0,	0,	351326,	226,	2459,	0,	20,
AB. RFG.	0, TON	0,0	105,	8,	0,	0,	0,	0,	20,
PRD.HTG.	7324, KW	1,000	60,	19,	0,	13,	93,	0,	20,
COOL TWR	43487, SM	0,700	60,	105,	273969,	2,	101,	0,	20,
COLD STO	0, CM	0,700	8,	17,	0,	0,	0,	0,	20,
AUX.ELEC	5606, KW	0,0	0,	0,	48506,	0,	0,	415,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=44,7% OF LOAD, UTILITY 31,1%, AND FOSSIL FUEL 113,6%

TOTAL CAP. INV. IS \$,80453E+07 WITH YEARLY REC'G. COSTS, ,25580E+07

ANNUALIZED COST OF \$,26963E+08 WITH A YEARLY SAVING OF =,13061E+08 DROI= -93,9%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN OMAHA, NEB.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 141142, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 519, LANG./DAY, HDD/YR OF 5459, CDD/YR OF 1444,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 4,38 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY KWH/DAY	INST'D CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
			DEG C	DEG C					
COLLECT.	14161, SM	0,298	206,	321,	24809,	100,	1416,	76,	20,
BATTSTO.	773, KWH	0,723	0,	0,	524,	95,	74,	16,	20,
HEAT EX.	12316, SM	0,954	321,	206,	373853,	15,	188,	0,	20,
AUX.HTG.	51775, KW	0,750	200,	371,	465397,	3,	174,	1343,	20,
PCS	9373, KW	0,241	371,	60,	90240,	340,	3190,	490,	20,
V.C.RFG.	9463, TON	4,500	0,	0,	294206,	239,	2258,	0,	20,
AB. RFG.	0, TON	0,0	105,	8,	0,	0,	0,	0,	20,
PRD.HTG.	6729, KW	1,000	60,	19,	0,	11,	99,	0,	20,
COOL TWR	26385, SM	0,700	60,	105,	213699,	3,	74,	0,	20,
COLD STO	0, CM	0,700	8,	17,	0,	0,	0,	0,	20,
AUX.ELEC	5101, KW	0,0	0,	0,	50959,	0,	0,	297,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=60,4% OF LOAD, UTILITY 29,0%, AND FOSSIL FUEL 131,4%

TOTAL CAP. INV. IS \$,74738E+07 WITH YEARLY REC'G. COSTS, ,22212E+07

ANNUALIZED COST OF \$,23492E+08 WITH A YEARLY SAVING OF =,12773E+08 DROI= -119,2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 140143,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 457,LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1285,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=12.29 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161. SM	0.261	233.	321.	19122.	100.	1416.	76.	20.
BATTSTU.	171. KWH	0.723	0.	0.	20.	95.	16.	4.	20.
HEAT EX.	15089. SM	0.941	321.	233.	439406.	14.	212.	0.	20.
AUX.HTG.	63435. KW	0.750	228.	371.	560383.	3.	186.	1617.	20.
PCS	9638. KW	0.203	371.	110.	89018.	337.	3250.	467.	20.
V.C.RFG.	6607. TON	4.500	0.	0.	100621.	275.	1814.	0.	20.
AB. RFG.	5653. TON	0.720	108.	8.	189086.	329.	1862.	0.	20.
PRO.HTG.	8299. KW	1.000	110.	19.	0.	12.	97.	0.	20.
COOL TWR	7536. SM	0.700	110.	108.	87824.	5.	35.	0.	20.
COLD STD	125. CM	0.700	8.	17.	0.	214.	37.	0.	20.
AUX.ELEC	2478. KW	0.0	0.	0.	9063.	0.	0.	228.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 21.4% OF LOAD,UTILITY 9.7%,AND FOSSIL FUEL 68.9%

TOTAL CAP. INV. IS \$,89151E+07 WITH YEARLY REC'G,COSTS, ,24118E+07

ANNUALIZED COST OF \$,25638E+08 WITH A YEARLY SAVING OF =,16507E+07 DROI= -6.9%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 133659,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 405,LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 1.90 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	14161. SM	0.219	206.	321.	14186.	100.	1416.	76.	20.
BATTSTU.	214. KWH	0.723	0.	0.	25.	95.	20.	5.	20.
HEAT EX.	10469. SM	0.954	321.	206.	334460.	16.	170.	0.	20.
AUX.HTG.	44010. KW	0.750	200.	371.	427035.	4.	165.	1232.	20.
PCS	7967. KW	0.241	371.	60.	80732.	360.	2866.	464.	20.
V.C.RFG.	7648. TON	4.500	0.	0.	260529.	259.	1983.	0.	20.
AB. RFG.	0. TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO.HTG.	8199. KW	1.000	60.	19.	0.	12.	97.	0.	20.
COOL TWR	16153. SM	0.700	60.	105.	185815.	3.	55.	0.	20.
COLD STD	0. CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX.ELEC	5369. KW	0.0	0.	0.	52934.	0.	0.	137.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES***** OF LOAD,UTILITY 23.9%,AND FOSSIL FUEL215.9%

TOTAL CAP. INV. IS \$,67728E+07 WITH YEARLY REC'G,COSTS, ,19141E+07

ANNUALIZED COST OF \$,20298E+08 WITH A YEARLY SAVING OF =,14157E+08 DROI= +230.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 69468, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 698, LANG./DAY, HDD/YR OF 4418, CDD/YR OF 1437,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.41 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'L D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CHPT. LIFE YEARS
COLLECT.	6988, SM	0.379	233.	321.	20916.	100.	699.	38.	20.
BATTSTO.	568, KWH	0.723	0.	0.	107.	78.	44.	10.	20.
HEAT EX.	7873, SM	0.941	321.	233.	220829.	18.	144.	0.	20.
AUX. HTG.	33099, KW	0.750	228.	371.	266549.	5.	151.	769.	20.
PCS	5029, KW	0.203	371.	110.	44737.	421.	2115.	350.	20.
V.C. RFG.	3449, TON	4.500	0.	0.	53814.	354.	1220.	0.	20.
AB. RFG.	2800, TON	0.699	108.	8.	90552.	407.	1139.	0.	20.
PRO. HTG.	4051, KW	1.000	110.	19.	0.	19.	77.	0.	20.
COOL TWR	4001, SM	0.700	110.	108.	46517.	6.	24.	0.	20.
COLD STO	356, CM	0.700	8.	17.	0.	129.	46.	0.	20.
AUX. ELEC	1226, KW	0.0	0.	0.	4485.	0.	0.	71.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES =0.6% OF LOAD, UTILITY 8.5%, AND FOSSIL FUEL 92.1%

TOTAL CAP. INV. IS \$,56590E+07 WITH YEARLY REC'G. COSTS, ,12378E+07

ANNUALIZED COST OF \$,13336E+08 WITH A YEARLY SAVING OF =,46551E+07 DROI= =53.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 66984, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 472, LANG./DAY, HDD/YR OF 6051, CDD/YR OF 636,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=12.71 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'L D CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CHPT. LIFE YEARS
COLLECT.	6988, SM	0.245	233.	321.	9164.	100.	699.	38.	20.
BATTSTO.	82, KWH	0.723	0.	0.	10.	95.	8.	2.	20.
HEAT EX.	6634, SM	0.941	321.	233.	205362.	20.	129.	0.	20.
AUX. HTG.	27889, KW	0.750	228.	371.	261596.	5.	143.	755.	20.
PCS	4237, KW	0.203	371.	110.	41604.	446.	1889.	338.	20.
V.C. RFG.	2798, TON	4.500	0.	0.	41686.	384.	1074.	0.	20.
AB. RFG.	2848, TON	0.718	108.	8.	91501.	405.	1152.	0.	20.
PRO. HTG.	4320, KW	1.000	110.	19.	0.	18.	79.	0.	20.
COOL TWR	3042, SM	0.700	110.	108.	36289.	7.	20.	0.	20.
COLD STO	114, CM	0.700	8.	17.	0.	223.	25.	0.	20.
AUX. ELEC	1197, KW	0.0	0.	0.	5005.	0.	0.	111.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 26.1% OF LOAD, UTILITY 9.4%, AND FOSSIL FUEL 64.4%

TOTAL CAP. INV. IS \$,52194E+07 WITH YEARLY REC'G. COSTS, ,12434E+07

ANNUALIZED COST OF \$,13320E+08 WITH A YEARLY SAVING OF =,12901E+07 DROI= =10.7%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 73590, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 515, LANG./DAY, HDD/YR OF 2371, CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 2.94 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT	SIZE, KS	CAP. INV. KS	REC'G CST. KS	CMPT. LIFE YEARS
COLLECT.	6988, SM	0.333	206.	321.	13576.	100.	699.	38.	20.	
BATTSTO.	213, KWH	0.723	0.	0.	25.	95.	20.	5.	20.	
HEAT EX.	6437, SM	0.954	321.	206.	195288.	20.	127.	0.	20.	
AUX.HTG.	27061, KW	0.750	200.	371.	242280.	5.	142.	699.	20.	
PCS	4899, KW	0.241	371.	60.	47138.	424.	2079.	359.	20.	
V.C.RFG.	5021, TON	4.500	0.	0.	162916.	306.	1534.	0.	20.	
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.	
PRO.HTG.	3761, KW	1.000	60.	19.	0.	20.	75.	0.	20.	
COOL TWR	16328, SM	0.700	60.	105.	119405.	3.	56.	0.	20.	
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.	
AUX.ELEC	2522, KW	0.0	0.	0.	26459.	0.	0.	115.	20.	

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES*****X OF LOAD, UTILITY 30.6%, AND FOSSIL FUEL 186.8%

TOTAL CAP. INV. IS \$,47324E+07 WITH YEARLY REC'G. COSTS, ,12151E+07

ANNUALIZED COST OF \$,12956E+08 WITH A YEARLY SAVING OF ,88818E+07 DROI= +218.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 73295, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 448, LANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.20 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE,	KS	YEARS
COLLECT.	6988, SM	0.289	206.	321.	10218.	100.	699.	38.	20.
BATTSTO.	10, KWH	0.723	0.	0.	1.	95.	1.	1.	20.
HEAT EX.	6154, SM	0.954	321.	206.	188940.	20.	124.	0.	20.
AUX. HTG.	25873, KW	0.750	200.	371.	238293.	5.	140.	687.	20.
PCS	4684, KW	0.241	371.	60.	45606.	431.	2018.	354.	20.
V.C. RFG.	4731, TON	4.500	0.	0.	161587.	313.	1479.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO. HTG.	3549, KW	1.000	60.	19.	0.	21.	74.	0.	20.
COOL TWR	13580, SM	0.700	60.	105.	116532.	4.	50.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. ELEC	2522, KW	0.0	0.	0.	27689.	0.	0.	179.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=52.7% OF LOAD, UTILITY 31.5%, AND FOSSIL FUEL 121.3%

TOTAL CAP. INV. IS \$,45850E+07 WITH YEARLY REC'G. COSTS, ,12579E+07

ANNUALIZED COST OF \$,13361E+08 WITH A YEARLY SAVING OF ,73647E+07 DROI= +122.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN LOS ANGELES, CA,
FLOOR AREA IS 70755,SQ.M AND ELECTRICAL DEMAND IS 68631,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 541,LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 7.63 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. SIZE, K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	6988, SM	0.391	181.	205.	16736.	100.	699.	38.	20.
BATTSTO.	355, KWH	0.723	0.	0.	65.	96.	34.	7.	20.
HEAT EX.	7266, SM	0.811	205.	181.	203365.	19.	137.	0.	20.
AUX.HTG.	30547, KW	0.750	175.	255.	248838.	5.	147.	718.	20.
PCS	3135, KW	0.137	255.	110.	27829.	494.	1549.	279.	20.
V.C.RFG.	1912, TON	4.500	0.	0.	9960.	445.	851.	0.	20.
AB, RFG.	4019, TON	0.805	108.	8.	130641.	365.	1467.	0.	20.
PRO.HTG.	3514, KW	1.000	110.	19.	0.	21.	74.	0.	20.
COOL TWR	3388, SM	0.700	110.	108.	13296.	6.	22.	0.	20.
COLD STO	857, CM	0.700	8.	17.	0.	84.	72.	0.	20.
AUX,ELEC	1415, KW	0.0	0.	0.	11296.	0.	0.	121.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=13.3% OF LOAD,UTILITY 16.3%,AND FOSSIL FUEL 97.0%

TOTAL CAP. INV. IS \$.50506E+07 WITH YEARLY REC'G.COSTS, .11623E+07

ANNUALIZED COST OF \$.12480E+08 WITH A YEARLY SAVING OF -.47660E+07 DROI= -61.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN MADISON, WIS,
FLOOR AREA IS 70755,SQ.M AND ELECTRICAL DEMAND IS 66932,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 516,LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 8.12 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. SIZE, K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	6988, SM	0.317	181.	205.	12942.	100.	699.	38.	20.
BATTSTO.	656, KWH	0.723	0.	0.	136.	85.	56.	11.	20.
HEAT EX.	6865, SM	0.811	205.	181.	206016.	19.	132.	0.	20.
AUX.HTG.	28860, KW	0.750	175.	255.	257431.	5.	145.	743.	20.
PCS	2962, KW	0.137	255.	110.	28192.	504.	1492.	281.	20.
V.C.RFG.	1691, TON	4.500	0.	0.	9767.	467.	790.	0.	20.
AB, RFG.	4005, TON	0.748	108.	8.	123189.	365.	1463.	0.	20.
PRO.HTG.	4589, KW	1.000	110.	19.	0.	17.	80.	0.	20.
COOL TWR	2945, SM	0.700	110.	108.	13081.	7.	20.	0.	20.
COLD STO	1059, CM	0.700	8.	17.	0.	76.	80.	0.	20.
AUX,ELEC	1415, KW	0.0	0.	0.	10936.	0.	0.	133.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES =8.4% OF LOAD,UTILITY 16.5%,AND FOSSIL FUEL 91.9%

TOTAL CAP. INV. IS \$.49565E+07 WITH YEARLY REC'G.COSTS, .12058E+07

ANNUALIZED COST OF \$.12900E+08 WITH A YEARLY SAVING OF -.45074E+07 DROI= -53.7%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER & LOCATED IN OMAHA, NEB,
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 69489, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 519, LANG./DAY, HDD/YR OF 5459, CDD/YR OF 1444,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 4.60 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, K\$	K\$	YEARS
COLLECT.	6988, SM	0.298	206.	321.	12242.	100.	699.	38.	20.
BATTSTU.	382, KWH	0.723	0.	0.	259.	96.	36.	8.	20.
HEAT EX.	6047, SM	0.954	321.	206.	183554.	20.	122.	0.	20.
AUX. HTG.	25421, KW	0.750	200.	371.	228413.	5.	139.	659.	20.
PCS	4602, KW	0.241	371.	60.	44306.	434.	1995.	349.	20.
V.C. RFG.	4650, TON	4.500	0.	0.	144462.	315.	1464.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRD. HTG.	4285, KW	1.000	60.	19.	0.	18.	79.	0.	20.
COOL TWR	12966, SM	0.700	60.	105.	104984.	4.	49.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. ELEC	2522, KW	0.0	0.	0.	25212.	0.	0.	154.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=56.0% OF LOAD, UTILITY 29.6%, AND FOSSIL FUEL 126.4%

TOTAL CAP. INV. IS \$.45828E+07 WITH YEARLY REC'G. COSTS, .12074E+07

ANNUALIZED COST OF \$.12854E+08 WITH A YEARLY SAVING OF =.73192E+07 DROI= -132.2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER & LOCATED IN MIAMI, FLA,
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 77285, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 524, LANG./DAY, HDD/YR OF 186, CDD/YR OF 3958,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 6.19 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, K\$	K\$	YEARS
COLLECT.	6988, SM	0.326	206.	321.	13523.	100.	699.	38.	20.
BATTSTU.	0, KWH	0.723	0.	0.	0.	0.	0.	1.	20.
HEAT EX.	6120, SM	0.954	321.	206.	206250.	20.	123.	0.	20.
AUX. HTG.	25727, KW	0.750	200.	371.	256967.	5.	139.	741.	20.
PCS	4657, KW	0.241	371.	60.	49785.	432.	2011.	369.	20.
V.C. RFG.	4683, TON	4.500	0.	0.	179544.	314.	1470.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRD. HTG.	3433, KW	1.000	60.	19.	0.	21.	73.	0.	20.
COOL TWR	13208, SM	0.700	60.	105.	130932.	4.	49.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. ELEC	2522, KW	0.0	0.	0.	27501.	0.	0.	234.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=43.4% OF LOAD, UTILITY 34.4%, AND FOSSIL FUEL 109.0%

TOTAL CAP. INV. IS \$.45650E+07 WITH YEARLY REC'G. COSTS, .13822E+07

ANNUALIZED COST OF \$.14604E+08 WITH A YEARLY SAVING OF =.74752E+07 DROI= -104.9%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 70614, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 415, LANG./DAY, HDD/YR OF 3632, CDD/YR OF 1807,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 4,64 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	SIZE, KS	CAP. INV. KS	REC'G CST. KS	CMPT. LIFE YEARS
COLLECT.	6988, SM	0.282	206,	321,	9241,	100,	699,	38,	20,	
BATTSTO.	0, KWH	0.723	0,	0,	0,	0,	0,	0,	20,	
HEAT EX.	6056, SM	0.954	321,	206,	182192,	20,	123,	0,	20,	
AUX.HTG.	25460, KW	0.750	200,	371,	230600,	5,	139,	665,	20,	
PCS	4609, KW	0.241	371,	60,	43977,	433,	1997,	348,	20,	
V.C.RFG.	4654, TON	4.500	0,	0,	149525,	315,	1465,	0,	20,	
AB, RFG.	0, TON	0.0	105,	8,	0,	0,	0,	0,	20,	
PRD, HTG.	3967, KW	1.000	60,	19,	0,	19,	77,	0,	20,	
COOL TWR	12996, SM	0.700	60,	105,	107306,	4,	49,	0,	20,	
COLD STO	0, CM	0.700	8,	17,	0,	0,	0,	0,	20,	
AUX.ELEC	2554, KW	0.0	0,	0,	26637,	0,	0,	165,	20,	

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=60,4% OF LOAD, UTILITY 31,8%, AND FOSSIL FUEL 128,6%

TOTAL CAP. INV. IS \$,45475E+07 WITH YEARLY REC'G. COSTS, ,12156E+07

ANNUALIZED COST OF \$,12932E+08 WITH A YEARLY SAVING OF =,74335E+07 DROI= -135,2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 70755, SQ. M AND ELECTRICAL DEMAND IS 75753, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 904, LANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 6,43 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, KS	KS	YEARS
COLLECT.	6988, SM	0.290	206.	321.	20748.	100.	699.	38.	20.
BATTSTO.	603, KWH	0.723	0.	0.	119.	78.	47.	11.	20.
HEAT EX.	6736, SM	0.954	321.	206.	214568.	19.	131.	0.	20.
AUX. HTG.	28319, KW	0.750	200.	371.	258425.	5.	144.	746.	20.
PCS	5306, KW	0.241	371.	60.	51792.	413.	2192.	376.	20.
V.C. RFG.	5351, TON	4.500	0.	0.	172649.	298.	1595.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO. HTG.	3592, KW	1.000	60.	19.	0.	21.	74.	0.	20.
COOL TWR	21424, SM	0.700	60.	105.	134787.	3.	66.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. ELEC	2770, KW	0.0	0.	0.	23981.	0.	0.	221.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=38,1% OF LOAD, UTILITY 31,6%, AND FOSSIL FUEL 106,5%

TOTAL CAP. INV. IS \$,49469E+07 WITH YEARLY REC'G. COSTS, ,13911E+07

ANNUALIZED COST OF \$,14756E+08 WITH A YEARLY SAVING OF =,73996E+07 DROI= -100,6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 65796,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 405,LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 1.95 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, K\$	K\$	YEARS
COLLECT.	6988, SM	0.219	206.	321.	7000.	100.	699.	38.	20.
BATTSTO.	105, KWH	0.723	0.	0.	12.	95.	10.	2.	20.
HEAT EX.	5135, SM	0.954	321.	206.	164093.	22.	111.	0.	20.
AUX.HTG.	21589, KW	0.750	200.	371.	209455.	6.	132.	604.	20.
PCS	3908, KW	0.241	371.	60.	39609.	458.	1791.	331.	20.
V.C.RFG.	3753, TON	4.500	0.	0.	127845.	342.	1285.	0.	20.
AB, RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO.HTG.	4023, KW	1.000	60.	19.	0.	19.	77.	0.	20.
COOL TWR	7930, SM	0.700	60.	105.	91209.	5.	36.	0.	20.
COLD STD	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX.ELEC	2653, KW	0.0	0.	0.	26192.	0.	0.	69.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES*****X OF LOAD,UTILITY 24.4%,AND FOSSIL FUEL212.8%

TOTAL CAP. INV. IS \$,41405E+07 WITH YEARLY REC'G.COSTS, ,10440E+07

ANNUALIZED COST OF \$,11145E+08 WITH A YEARLY SAVING OF =.80249E+07 DROI= =257.2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER E LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 68996,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 457,LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1285,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=12.44 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, K\$	K\$	K\$
COLLECT.	6988, SM	0.261	233.	371.	9436.	100.	699.	38.	20.
BATTSTO.	84, KWH	0.723	0.	0.	10.	95.	8.	2.	20.
HEAT EX.	7416, SM	0.941	321.	233.	215771.	19.	138.	0.	20.
AUX.HTG.	31177, KW	0.750	228.	371.	275111.	5.	148.	794.	20.
PCS	4737, KW	0.203	371.	110.	43712.	429.	2033.	347.	20.
V.C.RFG.	3235, TON	4.500	0.	0.	48875.	363.	1173.	0.	20.
AB, RFG.	2793, TON	0.722	108.	8.	93367.	407.	1137.	0.	20.
PRO.HTG.	4073, KW	1.000	110.	19.	0.	19.	77.	0.	20.
COOL TWR	3689, SM	0.700	110.	108.	42658.	6.	23.	0.	20.
COLD STO	62, CM	0.700	8.	17.	0.	301.	19.	0.	20.
AUX.ELEC	1233, KW	0.0	0.	0.	4515.	0.	0.	115.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 22.2% OF LOAD,UTILITY 9.8%,AND FOSSIL FUEL 68.0%

TOTAL CAP. INV. IS \$,54557E+07 WITH YEARLY REC'G.COSTS, ,12949E+07

ANNUALIZED COST OF \$,13875E+08 WITH A YEARLY SAVING OF =.18705E+07 DROI= =15.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 23500,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSULATION OF 472,LANG,/DAY, HDD/YR OF 6051, CDD/YR OF 636,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=12.68 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP,INV. K\$	REC'G CST. K\$	CMPT,LIFE YEARS
COLLECT.	2446, SM	0.298	181.	205.	3890.	100.	245.	13.	20.
BATTSTU.	145, KWH	0.723	0.	0.	17.	95.	14.	3.	20.
HEAT EX.	2419, SM	0.811	205.	181.	71439.	29.	71.	0.	20.
AUX,HTG.	10170, KW	0.750	175.	255.	90065.	10.	104.	260.	20.
PCS	1044, KW	0.137	255.	110.	9776.	718.	744.	170.	20.
V.C.RFG.	601, TON	4.500	0.	0.	3576.	699.	420.	0.	20.
AB, RFG.	1418, TON	0.767	108.	8.	43291.	499.	707.	0.	20.
PRO,HTG.	1520, KW	1.000	110.	19.	0.	37.	56.	0.	20.
COOL TWR	1046, SM	0.700	110.	108.	5211.	10.	11.	0.	20.
COLD STO	231, CM	0.700	8.	17.	0.	158.	37.	0.	20.
AUX,ELEC	495, KW	0.0	0.	0.	4011.	0.	0.	69.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 19.8% OF LOAD,UTILITY 16.9%,AND FOSSIL FUEL 63.3%

TOTAL CAP,INV. IS \$,24133E+07 WITH YEARLY REC'G,COSTS, ,51477E+06

ANNUALIZED COST OF \$,55557E+07 WITH A YEARLY SAVING OF -,12880E+07 DROI= -30.2%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN ALBUQUERQUE,N,M,
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 24369,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSULATION OF 698,LANG,/DAY, HDD/YR OF 4418, CDD/YR OF 1437,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 8.44 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP,INV. K\$	REC'G CST. K\$	CMPT,LIFE YEARS
COLLECT.	2446, SM	0.424	181.	205.	8195.	100.	245.	13.	20.
BATTSTU.	547, KWH	0.723	0.	0.	151.	76.	41.	8.	20.
HEAT EX.	3214, SM	0.811	205.	181.	78853.	26.	84.	0.	20.
AUX,HTG.	13514, KW	0.750	175.	255.	94210.	8.	113.	272.	20.
PCS	1387, KW	0.137	255.	110.	10790.	652.	904.	178.	20.
V.C.RFG.	858, TON	4.500	0.	0.	5820.	609.	522.	0.	20.
AB, RFG.	1287, TON	0.734	108.	8.	44960.	514.	661.	0.	20.
PRO,HTG.	1426, KW	1.000	110.	19.	0.	39.	55.	0.	20.
COOL TWR	1595, SM	0.700	110.	108.	6779.	9.	14.	0.	20.
COLD STO	619, CM	0.700	8.	17.	0.	98.	61.	0.	20.
AUX,ELEC	495, KW	0.0	0.	0.	3345.	0.	0.	42.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES -6.6% OF LOAD,UTILITY 14.2%,AND FOSSIL FUEL 92.5%

TOTAL CAP,INV. IS \$,27003E+07 WITH YEARLY REC'G,COSTS, ,51266E+06

ANNUALIZED COST OF \$,55815E+07 WITH A YEARLY SAVING OF -,24698E+07 DROI= -79.4%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN FORT WORTH, TEX.
 FLOOR AREA IS 70755, SQ, M AND ELECTRICAL DEMAND IS 25812, KWH/DAY AT 0, KWH/KW
 BASED ON INCIDENT INSOLATION OF 515, LANG, /DAY, HDD/YR OF 2371, CDD/YR OF 2766,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 3.53 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST, \$/UNIT SIZE,	CAP. INV. K\$	REC'G CST, K\$	CMPT. LIFE YEARS
COLLECT.	2446, SM	0.333	206.	321.	4752.	100.	245.	13.	20.
BATTSTO.	75, KWH	0.723	0.	0.	9.	95.	7.	2.	20.
HEAT EX.	2264, SM	0.954	321.	206.	68665.	30.	68.	0.	20.
AUX. HTG.	9516, KW	0.750	200.	371.	85218.	11.	101.	246.	20.
PCS	1723, KW	0.241	371.	60.	16574.	605.	1043.	218.	20.
V.C. RFG.	1764, TON	4.500	0.	0.	57272.	459.	811.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO. HTG.	1324, KW	1.000	60.	19.	0.	41.	54.	0.	20.
COOL TWR	5725, SM	0.700	60.	105.	41948.	5.	30.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. ELEC	881, KW	0.0	0.	0.	9240.	0.	0.	48.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=96.1% OF LOAD, UTILITY 32.0%, AND FOSSIL FUEL 164.1%

TOTAL CAP. INV. IS \$.23583E+07 WITH YEARLY REC'G. COSTS, .52686E+06

ANNUALIZED COST OF \$.56679E+07 WITH A YEARLY SAVING OF -.39926E+07 DROI= -238.3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN LAKE CHARLES, LA.
 FLOOR AREA IS 70755, SQ, M AND ELECTRICAL DEMAND IS 25709, KWH/DAY AT 0, KWH/KW
 BASED ON INCIDENT INSOLATION OF 448, LANG, /DAY, HDD/YR OF 1211, CDD/YR OF 2671,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 5.26 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST, \$/UNIT SIZE,	CAP. INV. K\$	REC'G CST, K\$	CMPT. LIFE YEARS
COLLECT.	2446, SM	0.289	206.	321.	3576.	100.	245.	13.	20.
BATTSTO.	3, KWH	0.723	0.	0.	0.	95.	0.	0.	20.
HEAT EX.	2165, SM	0.954	321.	206.	66455.	31.	66.	0.	20.
AUX. HTG.	9100, KW	0.750	200.	371.	83838.	11.	100.	242.	20.
PCS	1647, KW	0.241	371.	60.	16041.	615.	1013.	215.	20.
V.C. RFG.	1663, TON	4.500	0.	0.	56807.	470.	782.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO. HTG.	1250, KW	1.000	60.	19.	0.	42.	53.	0.	20.
COOL TWR	4773, SM	0.700	60.	105.	40952.	6.	27.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX. ELEC	881, KW	0.0	0.	0.	9668.	0.	0.	63.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=51.7% OF LOAD, UTILITY 31.4%, AND FOSSIL FUEL 120.3%

TOTAL CAP. INV. IS \$.22851E+07 WITH YEARLY REC'G. COSTS, .53317E+06

ANNUALIZED COST OF \$.57192E+07 WITH A YEARLY SAVING OF -.35364E+07 DROI= -162.0%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 24076, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 541, LANG./DAY, HDD/YR OF 1441, CDD/YR OF 1168,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 7.96 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD \$/UNIT	CST. CAP. INV. K\$	REC'G K\$	CMPT. LIFE YEARS
COLLECT.	2446, SM	0.391	181.	205.	5857.	100.	245.	13.	20.
BATTSTO.	124, KWH	0.723	0.	0.	23.	95.	12.	2.	20.
HEAT EX.	2559, SM	0.811	205.	181.	71598.	29.	73.	0.	20.
AUX. HTG.	10759, KW	0.750	175.	255.	87654.	10.	105.	253.	20.
PCS	1104, KW	0.137	255.	110.	9798.	704.	778.	170.	20.
V.C. RFG.	678, TON	4.500	0.	0.	3584.	667.	452.	0.	20.
AB. RFG.	1413, TON	0.805	108.	8.	45877.	499.	706.	0.	20.
PRO. HTG.	1238, KW	1.000	110.	19.	0.	43.	53.	0.	20.
COOL TWR	1202, SM	0.700	110.	108.	4809.	10.	12.	0.	20.
COLD STO	297, CM	0.700	8.	17.	0.	140.	42.	0.	20.
AUX. ELEC	495, KW	0.0	0.	0.	3924.	0.	0.	44.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=10.0% OF LOAD, UTILITY 16.3%, AND FOSSIL FUEL 93.8%

TOTAL CAP. INV. IS \$,24770E+07 WITH YEARLY REC'G. COSTS, ,48208E+06

ANNUALIZED COST OF \$,52383E+07 WITH A YEARLY SAVING OF =,23770E+07 DROI= -83.1%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN MADISON, WIS.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 23482, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 516, LANG./DAY, HDD/YR OF 7737, CDD/YR OF 620,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.28 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD \$/UNIT	CST. CAP. INV. K\$	REC'G K\$	CMPT. LIFE YEARS
COLLECT.	2446, SM	0.317	181.	205.	4530.	100.	245.	13.	20.
BATTSTO.	230, KWH	0.723	0.	0.	48.	85.	20.	4.	20.
HEAT EX.	2419, SM	0.811	205.	181.	72515.	29.	71.	0.	20.
AUX. HTG.	10170, KW	0.750	175.	255.	90647.	10.	104.	261.	20.
PCS	1044, KW	0.137	255.	110.	9923.	718.	749.	171.	20.
V.C. RFG.	601, TON	4.500	0.	0.	3515.	699.	420.	0.	20.
AB. RFG.	1409, TON	0.747	108.	8.	43270.	500.	704.	0.	20.
PRO. HTG.	1614, KW	1.000	110.	19.	0.	36.	57.	0.	20.
COOL TWR	1046, SM	0.700	110.	108.	4697.	10.	11.	0.	20.
COLD STO	368, CM	0.700	8.	17.	0.	126.	47.	0.	20.
AUX. ELEC	495, KW	0.0	0.	0.	3794.	0.	0.	47.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES =7.1% OF LOAD, UTILITY 16.4%, AND FOSSIL FUEL 90.7%

TOTAL CAP. INV. IS \$,24266E+07 WITH YEARLY REC'G. COSTS, ,49677E+06

ANNUALIZED COST OF \$,53774E+07 WITH A YEARLY SAVING OF =,23320E+07 DROI= -76.6%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN OMAHA, NEB.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 24377,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 519,LANG,/DAY, HDD/YR OF 5459, CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006START (IF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 4.95 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	2446, SM	0.298	206.	321.	4285.	100.	245.	13.	20.
BATTSTD.	134, KWH	0.723	0.	0.	90.	95.	13.	3.	20.
HEAT EX.	2127, SM	0.954	321.	206.	64569.	31.	65.	0.	20.
AUX.HTG.	8942, KW	0.750	200.	371.	80379.	11.	99.	232.	20.
PCS	1619, KW	0.241	371.	60.	15586.	618.	1001.	212.	20.
V.C.RFG.	1634, TON	4.500	0.	0.	50813.	473.	774.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO.HTG.	1508, KW	1.000	60.	19.	0.	37.	56.	0.	20.
COOL TWR	4557, SM	0.700	60.	105.	36909.	6.	26.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX,ELEC	881, KW	0.0	0.	0.	8801.	0.	0.	58.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=49.9% OF LOAD,UTILITY 29.9%,AND FOSSIL FUEL119.9%

TOTAL CAP. INV. IS \$.22791E+07 WITH YEARLY REC'G,COSTS, .51761E+06

ANNUALIZED COST OF \$.55622E+07 WITH A YEARLY SAVING OF =.34574E+07 DROI= =164.3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN WASHINGTON D.C.
FLOOR AREA IS 70755,SQ,M AND ELECTRICAL DEMAND IS 24204,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSOLATION OF 457,LANG,/DAY, HDD/YR OF 4236, CDD/YR OF 1285.

ASSUMPTIONS:

FOR A 2006START (IF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=12.67 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	2446, SM	0.329	168.	177.	4166.	100.	245.	13.	20.
BATTSTD.	615, KWH	0.723	0.	0.	194.	82.	50.	10.	20.
HEAT EX.	2693, SM	0.608	177.	168.	76521.	28.	75.	0.	20.
AUX.HTG.	11321, KW	0.750	163.	227.	96473.	9.	107.	278.	20.
PCS	991, KW	0.117	227.	110.	8927.	731.	724.	162.	20.
V.C.RFG.	460, TON	4.500	0.	0.	747.	776.	357.	0.	20.
AB. RFG.	1509, TON	0.743	108.	8.	49289.	490.	739.	0.	20.
PRO.HTG.	1433, KW	1.000	110.	19.	0.	39.	55.	0.	20.
COOL TWR	378, SM	0.700	110.	108.	1266.	15.	6.	0.	20.
COLD STO	1003, CM	0.700	8.	17.	0.	78.	78.	0.	20.
AUX,ELEC	495, KW	0.0	0.	0.	4234.	0.	0.	75.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 15.2% OF LOAD,UTILITY 18.0%,AND FOSSIL FUEL 66.8%

TOTAL CAP. INV. IS \$.24362E+07 WITH YEARLY REC'G,COSTS, .53906E+06

ANNUALIZED COST OF \$.58030E+07 WITH A YEARLY SAVING OF =.14668E+07 DROI= =33.8%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 24770, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 415, LANG./DAY, HDD/YR OF 3632, CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 5,04 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. KS	REC'G CST. KS	CMPT. LIFE YEARS
COLLECT.	2446, SM	0,282	206,	321,	3234,	100,	245,	13,	20,
BATTSTO.	0, KWH	0,723	0,	0,	0,	0,	0,	0,	20,
HEAT EX.	2130, SM	0,954	321,	206,	64097,	31,	66,	0,	20,
AUX. HTG.	8956, KW	0,750	200,	371,	81150,	11,	99,	234,	20,
PCS	1621, KW	0,241	371,	60,	15472,	618,	1002,	211,	20,
V.C. RFG.	1636, TON	4,500	0,	0,	52585,	473,	774,	0,	20,
AB. RFG.	0, TON	0,0	105,	8,	0,	0,	0,	0,	20,
PRO. HTG.	1396, KW	1,000	60,	19,	0,	39,	55,	0,	20,
COOL TWR	4567, SM	0,700	60,	105,	37725,	6,	26,	0,	20,
COLD STO	0, CM	0,700	8,	17,	0,	0,	0,	0,	20,
AUX. ELEC	893, KW	0,0	0,	0,	9299,	0,	0,	63,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=53,1% OF LOAD, UTILITY 32,3%, AND FOSSIL FUEL 120,8%

TOTAL CAP. INV. IS \$,22665E+07 WITH YEARLY REC'G. COSTS, ,52110E+06

ANNUALIZED COST OF \$,55952E+07 WITH A YEARLY SAVING OF -,34865E+07 DROI= -165,3%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN SEATTLE, WASH.
FLOOR AREA IS 70755, SQ.M AND ELECTRICAL DEMAND IS 23084, KWH/DAY AT 0, KWH/KW
BASED ON INCIDENT INSOLATION OF 405, LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254,

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0,159 K=0,080 G=0,050 GF=0,100 N= 20 FUEL= 2,37 \$/GJ, ELECT= 2,02 \$/GJ (1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE	CAP. INV. KS	REC'G CST. KS	CMPT. LIFE YEARS
COLLECT.	2446, SM	0,259	181,	205,	2905,	100,	245,	13,	20,
BATTSTO.	125, KWH	0,723	0,	0,	15,	95,	12,	2,	20,
HEAT EX.	2199, SM	0,811	205,	181,	68213,	30,	67,	0,	20,
AUX. HTG.	9245, KW	0,750	175,	255,	87078,	11,	100,	251,	20,
PCS	949, KW	0,137	255,	110,	9334,	742,	704,	166,	20,
V.C. RFG.	479, TON	4,500	0,	0,	3075,	764,	366,	0,	20,
AB. RFG.	1320, TON	0,777	108,	8,	41922,	510,	673,	0,	20,
PRO. HTG.	1416, KW	1,000	110,	19,	0,	39,	55,	0,	20,
COOL TWR	804, SM	0,700	110,	108,	4906,	11,	9,	0,	20,
COLD STO	177, CM	0,700	8,	17,	0,	180,	32,	0,	20,
AUX. ELEC	495, KW	0,0	0,	0,	4367,	0,	0,	13,	20,

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=*****% OF LOAD, UTILITY 12,8%, AND FOSSIL FUEL 247,0%

TOTAL CAP. INV. IS \$,22623E+07 WITH YEARLY REC'G. COSTS, ,44567E+06

ANNUALIZED COST OF \$,46382E+07 WITH A YEARLY SAVING OF -,36715E+07 DROI= -314,7%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN MIAMI, FLA,
FLOOR AREA IS 70755,SQ.M AND ELECTRICAL DEMAND IS 27105,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSULATION OF 524,LANG./DAY, HDD/YR OF 186, CDD/YR OF 3958,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 6.90 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, KS	KS	YEARS
COLLECT.	2446, SM	0.326	206.	321.	4733.	100.	245.	13.	20.
BATTSTO.	0, KWH	0.723	0.	0.	0.	0.	0.	0.	20.
HEAT EX.	2153, SM	0.954	321.	206.	72506.	31.	66.	0.	20.
AUX.HTG.	9049, KW	0.750	200.	371.	90363.	11.	100.	261.	20.
PCS	1638, KW	0.241	371.	60.	17501.	616.	1009.	224.	20.
V.C.RFG.	1646, TON	4.500	0.	0.	63092.	472.	777.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO.HTG.	1210, KW	1.000	60.	19.	0.	43.	52.	0.	20.
COOL TWR	4642, SM	0.700	60.	105.	45986.	6.	26.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX.ELEC	881, KW	0.0	0.	0.	9604.	0.	0.	91.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=34.1% OF LOAD,UTILITY 34.8%,AND FOSSIL FUEL 99.4%

TOTAL CAP. INV. IS \$,22748E+07 WITH YEARLY REC'G.COSTS, ,58919E+06

ANNUALIZED COST OF \$,62792E+07 WITH A YEARLY SAVING OF =,34822E+07 DROI= -124.5%

STES EQUIPMENT SIZES FOR A LARGE SHOPPING CENTER N LOCATED IN PHOENIX, ARIZ,
FLOOR AREA IS 70755,SQ.M AND ELECTRICAL DEMAND IS 26569,KWH/DAY AT 0,KWH/KW
BASED ON INCIDENT INSULATION OF 904,LANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 7.19 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'D CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, KS	KS	YEARS
COLLECT.	2446, SM	0.290	206.	321.	7262.	100.	245.	13.	20.
BATTSTO.	211, KWH	0.723	0.	0.	42.	78.	17.	4.	20.
HEAT EX.	2368, SM	0.954	321.	206.	75395.	29.	70.	0.	20.
AUX.HTG.	9956, KW	0.750	200.	371.	90844.	10.	103.	262.	20.
PCS	1863, KW	0.241	371.	60.	18199.	590.	1098.	228.	20.
V.C.RFG.	1880, TON	4.500	0.	0.	60678.	448.	842.	0.	20.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO.HTG.	1265, KW	1.000	60.	19.	0.	42.	53.	0.	20.
COOL TWR	7511, SM	0.700	60.	105.	47318.	5.	35.	0.	20.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX.ELEC	968, KW	0.0	0.	0.	8377.	0.	0.	87.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=28.9% OF LOAD,UTILITY 32.0%,AND FOSSIL FUEL 96.9%

TOTAL CAP. INV. IS \$,24626E+07 WITH YEARLY REC'G.COSTS, ,59376E+06

ANNUALIZED COST OF \$,63558E+07 WITH A YEARLY SAVING OF =,34634E+07 DROI= -119.7%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN ALBUQUERQUE, N.M.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 95300.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 698.LANG./DAY, HDD/YR OF 4418, CDD/YR OF 1437.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 8.66 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE. K\$	K\$	
COLLECT.	9853. SM	0.424	181.	205.	33014.	100.	985.	53.	20.
BATTSTO.	3292. KWH	0.723	0.	0.	4127.	76.	252.	50.	20.
HEAT EX.	12401. SM	0.811	205.	181.	339270.	15.	188.	0.	20.
AUX.HTG.	52134. KW	0.750	175.	255.	408339.	3.	175.	1105.	20.
PCS	5351. KW	0.137	255.	110.	46426.	412.	2204.	346.	20.
V.C.RFG.	3274. TON	4.500	0.	0.	17355.	361.	1182.	0.	20.
AB. RFG.	5093. TON	0.621	108.	8.	167992.	340.	1731.	0.	20.
PRO.HTG.	8640. KW	1.000	110.	19.	0.	11.	98.	0.	20.
COOL TWR	6086. SM	0.700	110.	108.	22336.	5.	31.	0.	20.
COLD STO	2707. CM	0.700	8.	17.	0.	48.	130.	0.	20.
AUX.ELEC	1995. KW	0.0	0.	0.	11446.	0.	0.	146.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES -0.8% OF LOAD, UTILITY 11.7%, AND FOSSIL FUEL 89.1%

TOTAL CAP. INV. IS \$.69759E+07 WITH YEARLY REC'G. COSTS, .16996E+07

ANNUALIZED COST OF \$.18181E+08 WITH A YEARLY SAVING OF -.53745E+07 DROI= -42.0%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN BLUE HILL, MASS.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 91307.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 472.LANG./DAY, HDD/YR OF 6051, CDD/YR OF 636.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT=13.10 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE. K\$	K\$	
COLLECT.	9853. SM	0.298	181.	205.	15671.	100.	985.	53.	20.
BATTSTO.	4627. KWH	0.723	0.	0.	5764.	79.	364.	73.	20.
HEAT EX.	10258. SM	0.811	205.	181.	323489.	16.	168.	0.	20.
AUX.HTG.	43126. KW	0.750	175.	255.	410422.	4.	164.	1110.	20.
PCS	4426. KW	0.137	255.	110.	44267.	439.	1944.	338.	20.
V.C.RFG.	2189. TON	4.500	0.	0.	11821.	422.	925.	0.	20.
AB. RFG.	5533. TON	0.599	108.	8.	155557.	332.	1834.	0.	20.
PRO.HTG.	10457. KW	1.000	110.	19.	0.	10.	104.	0.	20.
COOL TWR	2969. SM	0.700	110.	108.	19434.	7.	20.	0.	20.
COLD STO	795. CM	0.700	8.	17.	0.	87.	69.	0.	20.
AUX.ELEC	1995. KW	0.0	0.	0.	12616.	0.	0.	230.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 22.5% OF LOAD, UTILITY 13.3%, AND FOSSIL FUEL 64.2%

TOTAL CAP. INV. IS \$.65793E+07 WITH YEARLY REC'G. COSTS, .18046E+07

ANNUALIZED COST OF \$.19169E+08 WITH A YEARLY SAVING OF -.14698E+07 DROI= -8.3%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN FORT WORTH, TEX.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 101926.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 515.LANG./DAY, HDD/YR OF 2371, CDD/YR OF 2766.

ASSUMPTIONS:

FOR A 2006START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 2.89 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP,INV.	REC'G CST.	CMPT,LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT SZE.	K\$	K\$	YEARS
COLLECT.	9853. SM	0.333	206.	321.	19143.	100.	985.	53.	20.
BATTSTO.	6743. KWH	0.723	0.	0.	7474.	79.	533.	108.	20.
HEAT EX.	9112. SM	0.954	321.	206.	286114.	17.	157.	0.	20.
AUX,HTG.	38308. KW	0.750	200.	371.	355960.	4.	158.	963.	20.
PCS	6935. KW	0.241	371.	60.	69062.	377.	2615.	418.	20.
V.C.RFG.	7043. TON	4.500	0.	0.	215164.	268.	1886.	0.	20.
AB. RFG.	0. TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO,HTG.	6817. KW	1.000	60.	19.	0.	13.	91.	0.	20.
COOL TWR	22726. SM	0.700	60.	105.	157798.	3.	68.	0.	20.
COLD STO	0. CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX,ELEC	3388. KW	0.0	0.	0.	33469.	0.	0.	138.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES*****X OF LOAD,UTILITY 25.0X,AND FOSSIL FUEL175.2X

TOTAL CAP,INV. IS \$.64933E+07 WITH YEARLY REC'G.COSTS, .16792E+07

ANNUALIZED COST OF \$.17897E+08 WITH A YEARLY SAVING OF -.11988E+08 DROI= -202.9X

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN LAKE CHARLES, LA.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 101451.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 448.LANG./DAY, HDD/YR OF 1211, CDD/YR OF 2671.

ASSUMPTIONS:

FOR A 2006START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 5.32 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP,INV.	REC'G CST.	CMPT,LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT SZE.	K\$	K\$	YEARS
COLLECT.	9853. SM	0.289	206.	321.	14408.	100.	985.	53.	20.
BATTSTO.	2646. KWH	0.723	0.	0.	1768.	77.	204.	42.	20.
HEAT EX.	8658. SM	0.954	321.	206.	263555.	18.	152.	0.	20.
AUX,HTG.	36398. KW	0.750	200.	371.	332194.	4.	156.	899.	20.
PCS	6589. KW	0.241	371.	60.	63617.	384.	2528.	402.	20.
V.C.RFG.	6600. TON	4.500	0.	0.	213028.	275.	1813.	0.	20.
AB. RFG.	0. TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRO,HTG.	5508. KW	1.000	60.	19.	0.	15.	85.	0.	20.
COOL TWR	18559. SM	0.700	60.	105.	154162.	3.	60.	0.	20.
COLD STO	0. CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX,ELEC	3501. KW	0.0	0.	0.	37995.	0.	0.	235.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=45.1X OF LOAD,UTILITY 30.1X,AND FOSSIL FUEL115.1X

TOTAL CAP,INV. IS \$.59837E+07 WITH YEARLY REC'G.COSTS, .16303E+07

ANNUALIZED COST OF \$.17324E+08 WITH A YEARLY SAVING OF -.91100E+07 DROI= -110.9X

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN LOS ANGELES, CA.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 93955.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 541.LANG./DAY, HDD/YR OF 1441. CDD/YR OF 1160.

ASSUMPTIONS:

FOR A 2006START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 7.67 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
COLLECT.	9853. SM	0.391	181.	205.	23597.	100.	985.	53.	20.
BATTSTO.	501. KWH	0.723	0.	0.	96.	96.	48.	10.	20.
HEAT EX.	9249. SM	0.811	205.	181.	277005.	17.	158.	0.	20.
AUX.MTG.	38883. KW	0.750	175.	255.	337876.	4.	159.	914.	20.
PCS	3991. KW	0.137	255.	110.	37906.	455.	1816.	314.	20.
V.C.RFG.	1925. TON	4.500	0.	0.	6108.	444.	855.	0.	20.
AB. RFG.	5594. TON	0.759	108.	8.	173188.	330.	1849.	0.	20.
PRO.MTG.	5302. KW	1.000	110.	19.	0.	16.	84.	0.	20.
COOL TWR	2099. SM	0.700	110.	108.	10933.	8.	16.	0.	20.
COLD STO	1474. CM	0.700	8.	17.	0.	65.	95.	0.	20.
AUX,ELEC	1995. KW	0.0	0.	0.	16977.	0.	0.	168.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES -8.9% OF LOAD,UTILITY 16.9%,AND FOSSIL FUEL 92.0%

TOTAL CAP.INV. IS \$.60651E+07 WITH YEARLY REC'G.COSTS, .14585E+07

ANNUALIZED COST OF \$.15615E+08 WITH A YEARLY SAVING OF -.53029E+07 DROI= -51.4%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN MADISON, WIS.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 91224.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 516.LANG./DAY, HDD/YR OF 7737. CDD/YR OF 620.

ASSUMPTIONS:

FOR A 2006START OF OPERATION. COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 8.40 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	CAP.INV. K\$	REC'G CST. K\$	CMPT.LIFE YEARS
COLLECT.	9853. SM	0.317	181.	205.	18248.	100.	985.	53.	20.
BATTSTO.	7396. KWH	0.723	0.	0.	12901.	69.	509.	102.	20.
HEAT EX.	11118. SM	0.811	205.	181.	348198.	16.	177.	0.	20.
AUX.MTG.	46739. KW	0.750	175.	255.	439931.	4.	169.	1190.	20.
PCS	4797. KW	0.137	255.	110.	47648.	427.	2050.	350.	20.
V.C.RFG.	2674. TON	4.500	0.	0.	14667.	391.	1045.	0.	20.
AB. RFG.	5573. TON	0.548	108.	8.	152339.	331.	1844.	0.	20.
PRO.MTG.	12126. KW	1.000	110.	19.	0.	9.	110.	0.	20.
COOL TWR	3456. SM	0.700	110.	108.	22732.	6.	22.	0.	20.
COLD STO	1588. CM	0.700	8.	17.	0.	62.	99.	0.	20.
AUX,ELEC	1995. KW	0.0	0.	0.	10266.	0.	0.	148.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES -2.0% OF LOAD,UTILITY 11.3%,AND FOSSIL FUEL 90.8%

TOTAL CAP.INV. IS \$.70090E+07 WITH YEARLY REC'G.COSTS, .18434E+07

ANNUALIZED COST OF \$.19628E+08 WITH A YEARLY SAVING OF -.61294E+07 DROI= -45.4%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN MIAMI, FLA.
FLOOR AREA IS 42453.80.M AND ELECTRICAL DEMAND IS 107865.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 524.LANG./DAY, HDD/YR OF 186. CDD/YR OF 3958.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 6.08 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	9853. SM	0.326	206.	321.	19068.	100.	985.	53.	20.
BATTSTO.	0. KWH	0.723	0.	0.	0.	0.	0.	1.	20.
HEAT EX.	8602. SM	0.954	321.	206.	280564.	18.	151.	0.	20.
AUX.HTG.	36164. KW	0.750	200.	371.	348661.	4.	155.	943.	20.
PCS	6547. KW	0.241	371.	60.	67722.	385.	2518.	414.	20.
V.C.RFG.	6546. TON	4.500	0.	0.	241891.	276.	1804.	0.	20.
AB. RFG.	0. TON	0.0	105.	8.	0.	0.	0.	0.	20.
PRU.HTG.	5008. KW	1.000	60.	19.	0.	16.	83.	0.	20.
COOL TWR	18018. SM	0.700	60.	105.	177758.	3.	59.	0.	20.
COLD STO	0. CM	0.700	8.	17.	0.	0.	0.	0.	20.
AUX.ELEC	3278. KW	0.0	0.	0.	40143.	0.	0.	307.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=42.9% OF LOAD, UTILITY 35.1%, AND FOSSIL FUEL 107.8%

TOTAL CAP. INV. IS \$.57550E+07 WITH YEARLY REC'G. COSTS, .17187E+07

ANNUALIZED COST OF \$.18173E+08 WITH A YEARLY SAVING OF -.90171E+07 DROI= -98.5%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN NASHVILLE, TENN.
FLOOR AREA IS 42453.80.M AND ELECTRICAL DEMAND IS 97142.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 415.LANG./DAY, HDD/YR OF 3632. CDD/YR OF 1807.

ASSUMPTIONS:

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ, ELECT= 4.67 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$	CMPT. LIFE YEARS
COLLECT.	9853. SM	0.353	168.	177.	16327.	100.	985.	53.	20.
BATTSTO.	1318. KWH	0.723	0.	0.	1174.	95.	126.	25.	20.
HEAT EX.	11656. SM	0.608	177.	168.	343628.	16.	182.	0.	20.
AUX.HTG.	49003. KW	0.750	163.	227.	436667.	3.	171.	1181.	20.
PCS	4288. KW	0.117	227.	110.	40113.	444.	1904.	323.	20.
V.C.RFG.	2867. TON	4.500	0.	0.	6172.	380.	1090.	0.	20.
AB. RFG.	6031. TON	0.639	108.	8.	187467.	323.	1949.	0.	20.
PRU.HTG.	8175. KW	1.000	110.	19.	0.	12.	97.	0.	20.
COOL TWR	5393. SM	0.700	110.	108.	10365.	5.	29.	0.	20.
COLD STO	2845. CM	0.700	8.	17.	0.	47.	133.	0.	20.
AUX.ELEC	1995. KW	0.0	0.	0.	15052.	0.	0.	104.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=64.1% OF LOAD, UTILITY 13.3%, AND FOSSIL FUEL 150.8%

TOTAL CAP. INV. IS \$.66654E+07 WITH YEARLY REC'G. COSTS, .16865E+07

ANNUALIZED COST OF \$.17999E+08 WITH A YEARLY SAVING OF -.97653E+07 DROI= -118.6%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN OMAHA, NEB.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 95334.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 519.LANG./DAY, HDD/YR OF 5459, CDD/YR OF 1444.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 4.61 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE. KS	KS	YEARS
COLLECT.	9853. SM	0.352	168.	177.	20377.	100.	985.	53.	20.
BATTSTO.	3379. KWH	0.723	0.	0.	4427.	78.	264.	53.	20.
HEAT EX.	10848. SM	0.608	177.	168.	362902.	16.	174.	0.	20.
AUX.MTG.	45607. KW	0.750	163.	227.	456699.	4.	167.	1236.	20.
PCS	3991. KW	0.117	227.	110.	42339.	455.	1816.	331.	20.
V.C.RFG.	2173. TON	4.500	0.	0.	4187.	424.	920.	0.	20.
AB. RFG.	6585. TON	0.572	108.	8.	181315.	315.	2072.	0.	20.
PRO.MTG.	10177. KW	1.000	110.	19.	0.	10.	104.	0.	20.
COOL TWR	2072. SM	0.700	110.	108.	3595.	8.	16.	0.	20.
COLD STO	5878. CM	0.700	8.	17.	0.	33.	194.	0.	20.
AUX.ELEC	1995. KW	0.0	0.	0.	12629.	0.	0.	86.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=56.5% OF LOAD,UTILITY 10.2%,AND FOSSIL FUEL146.3%

TOTAL CAP. INV. IS \$.67132E+07 WITH YEARLY REC'G.COSTS, .17587E+07

ANNUALIZED COST OF \$.18730E+08 WITH A YEARLY SAVING OF -.98824E+07 DROI= -111.7%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN PHOENIX, ARIZ.
FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 105402.KWH/DAY AT 0.KWH/KW
BASED ON INCIDENT INSOLATION OF 904.LANG./DAY, HDD/YR OF 1973, CDD/YR OF 3464.

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 6.34 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD

WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD CST.	CAP. INV.	REC'G CST.	CMPT. LIFE
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE. KS	KS	YEARS
COLLECT.	9853. SM	0.285	233.	321.	28771.	100.	985.	53.	20.
BATTSTO.	4033. KWH	0.723	0.	0.	8005.	78.	316.	66.	20.
HEAT EX.	13218. SM	0.941	321.	233.	372515.	15.	196.	0.	20.
AUX.MTG.	55566. KW	0.750	228.	371.	458329.	3.	178.	1240.	20.
PCS	8469. KW	0.203	371.	110.	75466.	352.	2984.	436.	20.
V.C.RFG.	6377. TON	4.500	0.	0.	112144.	278.	1775.	0.	20.
AB. RFG.	3620. TON	0.594	108.	8.	118665.	377.	1363.	0.	20.
PRO.MTG.	5591. KW	1.000	110.	19.	0.	15.	85.	0.	20.
COOL TWR	8145. SM	0.700	110.	108.	97404.	5.	37.	0.	20.
COLD STO	160. CM	0.700	8.	17.	0.	189.	30.	0.	20.
AUX.ELEC	1851. KW	0.0	0.	0.	3714.	0.	0.	53.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES=34.8% OF LOAD,UTILITY 5.5%,AND FOSSIL FUEL129.3%

TOTAL CAP. INV. IS \$.79502E+07 WITH YEARLY REC'G.COSTS, .18478E+07

ANNUALIZED COST OF \$.19826E+08 WITH A YEARLY SAVING OF -.97983E+07 DROI= -97.7%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN SEATTLE, WASH.
 FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 89398.KWH/DAY AT 0.KWH/KW
 BASED ON INCIDENT INSOLATION OF 405.LANG./DAY, HDD/YR OF 5242, CDD/YR OF 254,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT= 2.01 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY KWH/DAY	INST'D CST.	CAP,INV.	REC'G CST.	CMPT,LIFE YEARS
			DEG C	DEG C		\$/UNIT SZE.	K\$	K\$	
COLLECT.	9853. SM	0.259	181.	205.	11702.	100.	985.	53.	20.
BATTSTU.	1719. KWH	0.723	0.	0.	1563.	83.	143.	29.	20.
HEAT EX.	9345. SM	0.811	205.	181.	301467.	17.	159.	0.	20.
AUX,MTG.	39285. KW	0.750	175.	255.	386353.	4.	160.	1045.	20.
PCS	4032. KW	0.137	255.	110.	41253.	453.	1828.	327.	20.
V.C.RFG.	1652. TON	4.500	0.	0.	8855.	471.	779.	0.	20.
AB. RFG.	5005. TON	0.619	108.	8.	149935.	342.	1710.	0.	20.
PRO,MTG.	8683. KW	1.000	110.	19.	0.	11.	98.	0.	20.
COOL TWR	2371. SM	0.700	110.	108.	18129.	7.	18.	0.	20.
COLD STO	473. CM	0.700	8.	17.	0.	112.	53.	0.	20.
AUX,ELEC	1995. KW	0.0	0.	0.	14850.	0.	0.	45.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES***** OF LOAD,UTILITY 8.4%,AND FOSSIL FUEL195.5%

TOTAL CAP,INV. IS \$.59326E+07 WITH YEARLY REC'G.COSTS, .14990E+07

ANNUALIZED COST OF \$.15999E+08 WITH A YEARLY SAVING OF -.10312E+08 DROI= -181.3%

STES EQUIPMENT SIZES FOR A MEDIUM SHOPPING CENTER LOCATED IN WASHINGTON D.C.
 FLOOR AREA IS 42453.SQ.M AND ELECTRICAL DEMAND IS 94541.KWH/DAY AT 0.KWH/KW
 BASED ON INCIDENT INSOLATION OF 457.LANG./DAY, HDD/YR OF 4236, CDD/YR OF 1265,

ASSUMPTIONS:

FOR A 2006START OF OPERATION, COST PARAMETERS ARE

FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37 \$/GJ,ELECT=12.82 \$/GJ(1976 \$)

RANKINE CYCLE STES CONCEPT WITH PCS CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY KWH/DAY	INST'D CST.	CAP,INV.	REC'G CST.	CMPT,LIFE YEARS
			DEG C	DEG C		\$/UNIT SZE.	K\$	K\$	
COLLECT.	9853. SM	0.318	181.	205.	16181.	100.	985.	53.	20.
BATTSTU.	2766. KWH	0.723	0.	0.	2700.	72.	199.	40.	20.
HEAT EX.	11604. SM	0.811	205.	181.	327374.	16.	181.	0.	20.
AUX,MTG.	48782. KW	0.750	175.	255.	414922.	4.	171.	1123.	20.
PCS	5007. KW	0.137	255.	110.	44799.	421.	2109.	340.	20.
V.C.RFG.	2833. TON	4.500	0.	0.	14340.	382.	1082.	0.	20.
AB. RFG.	5643. TON	0.648	108.	8.	167594.	330.	1860.	0.	20.
PRO,MTG.	8867. KW	1.000	110.	19.	0.	11.	99.	0.	20.
COOL TWR	5179. SM	0.700	110.	108.	23933.	5.	28.	0.	20.
COLD STO	653. CM	0.700	8.	17.	0.	96.	63.	0.	20.
AUX,ELEC	1995. KW	0.0	0.	0.	12610.	0.	0.	241.	20.

COST ANALYSIS RESULTS:

SOLAR ENERGY FURNISHES 18.6% OF LOAD,UTILITY 14.4%,AND FOSSIL FUEL 67.0%

TOTAL CAP,INV. IS \$.67773E+07 WITH YEARLY REC'G.COSTS, .17964E+07

ANNUALIZED COST OF \$.19119E+08 WITH A YEARLY SAVING OF -.19613E+07 DROI= -11.4%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN ALBUQUERQUE, N.M. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 33294.KWH/DAY AT 297.KWH/KW
 BASED ON INSULATION OF 684.LANG./DAY, HDD/YR OF 4568, CDD/YR OF 1450.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 8.53\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	LD CST. K\$	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	4752.SM	0.376	218.	316.	13844.	100.	475.	26.	
BATTSTO.	678.KWH	0.723	0.	0.	258.	95.	65.	13.	
HEAT EX.	3350.SM	0.946	316.	218.	78697.	26.	86.	0.	
AUX.HTG.	14084.KW	0.750	213.	338.	86471.	8.	115.	249.	
PCS	1969.KW	0.186	338.	110.	14666.	579.	1139.	206.	
V.C.RFG.	693.TON	4.500	0.	0.	1813.	661.	458.	0.	
AB. RFG.	1558.TON	0.701	108.	8.	39935.	485.	755.	0.	
PRO.HTG.	1734.KW	1.000	110.	19.	0.	34.	59.	0.	
COOL THR	891.SM	0.700	110.	108.	7096.	11.	10.	0.	
COLD STO	437.CM	0.700	8.	17.	0.	116.	51.	0.	
AUX.ELEC	962.KW	0.0	0.	0.	9744.	0.	0.	103.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES 9.8% OF LOAD, UTILITY 26.4%, AND FOSSIL FUEL 63.9%
 TOTAL CAP. INV. IS \$.32130E+07 WITH YEARLY REC'D COSTS, .5974E+06
 ANNUALIZED COST OF \$.6515E+07 WITH A YEARLY SAVING OF -.2434E+07 DROI= -59.7%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN BLUE HILL, MASS. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 31942.KWH/DAY AT 304.KWH/KW
 BASED ON INSULATION OF 446.LANG./DAY, HDD/YR OF 5917, CDD/YR OF 655.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT=12.84\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT	LD CST. K\$	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	4752.SM	0.241	233.	349.	5779.	100.	475.	26.	
BATTSTO.	97.KWH	0.723	0.	0.	38.	95.	9.	3.	
HEAT EX.	2331.SM	0.954	349.	233.	68060.	30.	69.	0.	
AUX.HTG.	9614.KW	0.750	228.	371.	83041.	11.	102.	240.	
PCS	1489.KW	0.203	371.	110.	13788.	636.	947.	200.	
V.C.RFG.	402.TON	4.500	0.	0.	1760.	818.	329.	0.	
AB. RFG.	1319.TON	0.708	108.	8.	33901.	510.	672.	0.	
PRO.HTG.	1887.KW	1.000	110.	19.	0.	32.	60.	0.	
COOL THR	830.SM	0.700	110.	108.	6411.	11.	9.	0.	
COLD STO	84.CM	0.700	8.	17.	0.	258.	22.	0.	
AUX.ELEC	962.KW	0.0	0.	0.	10613.	0.	0.	164.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES 26.7% OF LOAD, UTILITY 29.8%, AND FOSSIL FUEL 43.5%
 TOTAL CAP. INV. IS \$.26954E+07 WITH YEARLY REC'D COSTS, .6324E+06
 ANNUALIZED COST OF \$.6782E+07 WITH A YEARLY SAVING OF -.1115E+07 DROI= -19.7%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN FORT WORTH, TEX. FLOOR AREA IS 18868, SQ. M
 ELECTRICAL DEMAND IS 35387, KWH/DAY AT 302, KWH/KW
 BASED ON INSOLATION OF 524, LANG./DAY, HDD/YR OF 2391, CDD/YR OF 2680.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 3.36\$/GJ (1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'L D \$/UNIT	LD CST. K\$	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	4752, SM	0.320	206.	349.	9014.	100.	475.	26.	
BATTSTO.	363, KWH	0.723	0.	0.	130.	96.	35.	9.	
HEAT EX.	2485, SM	0.963	349.	206.	65885.	29.	72.	0.	
AUX. HTG.	8677, KW	0.750	200.	371.	75827.	11.	98.	219.	
PCS	1891, KW	0.241	371.	60.	15903.	587.	1109.	214.	
V.C. RFG.	1768, TON	4.500	0.	0.	51164.	459.	812.	0.	
AB, RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	
PRO. HTG.	1511, KW	1.000	60.	19.	0.	37.	56.	0.	
COOL TWR	7174, SM	0.700	60.	105.	40878.	5.	34.	0.	
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	
AUX. ELEC	1895, KW	0.0	0.	0.	19503.	0.	0.	90.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=71.6% OF LOAD, UTILITY 49.8%, AND FOSSIL FUEL 121.7%
 TOTAL CAP. INV. IS \$.26916E+07 WITH YEARLY REC'G. COSTS, .5566E+06
 ANNUALIZED COST OF \$.6021E+07 WITH A YEARLY SAVING OF -.4045E+07 DROI=-204.7%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN LAKE CHARLES, LA. FLOOR AREA IS 18868, SQ. M
 ELECTRICAL DEMAND IS 35256, KWH/DAY AT 312, KWH/KW
 BASED ON INSOLATION OF 447, LANG./DAY, HDD/YR OF 1264, CDD/YR OF 2603.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 5.27\$/GJ (1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'L D \$/UNIT	LD CST. K\$	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	4752, SM	0.278	206.	349.	6688.	100.	475.	26.	
BATTSTO.	118, KWH	0.723	0.	0.	16.	92.	11.	3.	
HEAT EX.	2083, SM	0.963	349.	206.	61201.	31.	65.	0.	
AUX. HTG.	8069, KW	0.750	200.	371.	72684.	12.	96.	210.	
PCS	1585, KW	0.241	371.	60.	14773.	623.	987.	207.	
V.C. RFG.	1617, TON	4.500	0.	0.	50574.	475.	769.	0.	
AB, RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.	
PRO. HTG.	1331, KW	1.000	60.	19.	0.	41.	54.	0.	
COOL TWR	5266, SM	0.700	60.	105.	38706.	5.	28.	0.	
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.	
AUX. ELEC	1895, KW	0.0	0.	0.	20488.	0.	0.	133.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=34.0% OF LOAD, UTILITY 52.1%, AND FOSSIL FUEL 82.0%
 TOTAL CAP. INV. IS \$.24853E+07 WITH YEARLY REC'G. COSTS, .5785E+06
 ANNUALIZED COST OF \$.6206E+07 WITH A YEARLY SAVING OF -.3477E+07 DROI=-127.4%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN LOS ANGELES, CA. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 32906.KWH/DAY AT 312.KWH/KW
 BASED ON INSOLATION OF 548.LANG./DAY, HDD/YR OF 1450, CDD/YR OF 1222.

ASSUMPTIONS

FOR A 2006START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ,ELECT= 7.88\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD \$/UNIT SZF.	CST.CAP. K\$	INV.REC'G K\$
COLLECT.	4752.SM	0.341	218.	316.	10049.	100.	475.	26.
BATTSTO.	355.KWH	0.723	0.	0.	88.	95.	34.	7.
HEAT EX.	2343.SM	0.946	316.	218.	68042.	30.	69.	0.
AUX.HTG.	9849.KW	0.750	213.	338.	77325.	10.	102.	223.
PCS	1390.KW	0.186	338.	110.	12681.	651.	905.	192.
V.C.RFG.	321.TON	4.500	0.	0.	060.	893.	287.	0.
AB.RFG.	1342.TON	0.809	108.	8.	39343.	507.	681.	0.
PRO.HTG.	1305.KW	1.000	110.	19.	0.	41.	54.	0.
COOL TWR	972.SM	0.700	110.	108.	6748.	11.	10.	0.
COLD STD	116.CM	0.700	8.	17.	0.	222.	26.	0.
AUX.ELEC	962.KW	0.0	0.	0.	11474.	0.	0.	113.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES 2.5% OF LOAD,UTILITY 32.8%,AND FOSSIL FUEL 64.7%
 TOTAL CAP.INV. IS \$.26432E+07 WITH YEARLY REC'G.COSTS, .5611E+06
 ANNUALIZED COST OF \$.6058E+07 WITH A YEARLY SAVING OF -.2451E+07 DROI= -68.0%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN MADISON, WIS. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 31824.KWH/DAY AT 303.KWH/KW
 BASED ON INSOLATION OF 491.LANG./DAY, HDD/YR OF 7931, CDD/YR OF 585.

ASSUMPTIONS

FOR A 2006START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ,ELECT= 8.36\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD \$/UNIT SZF.	CST.CAP. K\$	INV.REC'G K\$
COLLECT.	4752.SM	0.272	218.	316.	7177.	100.	475.	26.
BATTSTO.	219.KWH	0.723	0.	0.	143.	95.	21.	5.
HEAT EX.	2319.SM	0.946	316.	218.	72055.	30.	69.	0.
AUX.HTG.	9749.KW	0.750	213.	338.	86504.	10.	102.	250.
PCS	1363.KW	0.186	338.	110.	13428.	656.	894.	197.
V.C.RFG.	277.TON	4.500	0.	0.	1173.	946.	262.	0.
AB.RFG.	1328.TON	0.668	108.	8.	33957.	509.	676.	0.
PRO.HTG.	2120.KW	1.000	110.	19.	0.	30.	63.	0.
COOL TWR	955.SM	0.700	110.	108.	7800.	11.	10.	0.
COLD STD	162.CM	0.700	8.	17.	0.	188.	30.	0.
AUX.ELEC	962.KW	0.0	0.	0.	10845.	0.	0.	110.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES 6.7% OF LOAD,UTILITY 28.5%,AND FOSSIL FUEL 64.8%
 TOTAL CAP.INV. IS \$.26014E+07 WITH YEARLY REC'G.COSTS, .5869E+06
 ANNUALIZED COST OF \$.6310E+07 WITH A YEARLY SAVING OF -.2299E+07 DROI= -57.3%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN MIAMI, FLA. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 37492.KWH/DAY AT 333.KWH/KW
 BASED ON INSULATION OF 518.LANG./DAY, HDD/YR OF 176. CDD/YR OF 3917.

ASSUMPTIONS
 FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 6.68\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD \$/UNIT	CAP. INV. K\$	REC'G K\$
COLLECT.	4752.SM	0.343	206.	288.	9549.	100.	475.	26.
BATTSTO.	127.KWH	0.723	0.	0.	42.	95.	12.	2.
HEAT EX.	3332.SM	0.937	288.	206.	95708.	26.	86.	0.
AUX.HTG.	13778.KW	0.750	200.	310.	114877.	8.	114.	331.
PCS	1801.KW	0.171	310.	110.	16407.	596.	1074.	217.
V.C.RFG.	678.TON	4.500	0.	0.	4217.	667.	452.	0.
AB. RFG.	1599.TON	0.782	108.	8.	56422.	481.	769.	0.
PRO.HTG.	1210.KW	1.000	110.	19.	0.	43.	52.	0.
COOL TWR	996.SM	0.700	110.	108.	7143.	10.	10.	0.
COLD STO	73.CM	0.700	8.	17.	0.	278.	20.	0.
AUX.ELEC	962.KW	0.0	0.	0.	8542.	0.	0.	85.

COST ANALYSIS RESULTS
 SOLAR ENERGY FURNISHES=25.7% OF LOAD, UTILITY 25.6%, AND FOSSIL FUEL 100.1%
 TOTAL CAP. INV. IS \$.30658E+07 WITH YEARLY REC'G. COSTS, .6615E+06
 ANNUALIZED COST OF \$.7133E+07 WITH A YEARLY SAVING OF -.3649E+07 DROI=-104.8%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN NASHVILLE, TENN. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 33906.KWH/DAY AT 301.KWH/KW
 BASED ON INSULATION OF 394.LANG./DAY, HDD/YR OF 3650. CDD/YR OF 1809.

ASSUMPTIONS
 FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 4.95\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD \$/UNIT	CAP. INV. K\$	REC'G K\$
COLLECT.	4752.SM	0.259	206.	349.	5492.	100.	475.	26.
BATTSTO.	70.KWH	0.723	0.	0.	17.	95.	7.	3.
HEAT EX.	1999.SM	0.963	349.	206.	58225.	32.	63.	0.
AUX.HTG.	7962.KW	0.750	200.	371.	70311.	12.	96.	203.
PCS	1521.KW	0.241	371.	60.	14054.	632.	961.	202.
V.C.RFG.	1603.TON	4.500	0.	0.	44500.	477.	764.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	1644.KW	1.000	60.	19.	0.	35.	58.	0.
COOL TWR	5093.SM	0.700	60.	105.	33558.	5.	28.	0.
COLD STO	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	1895.KW	0.0	0.	0.	19857.	0.	0.	126.

COST ANALYSIS RESULTS
 SOLAR ENERGY FURNISHES=34.0% OF LOAD, UTILITY 51.2%, AND FOSSIL FUEL 82.8%
 TOTAL CAP. INV. IS \$.24515E+07 WITH YEARLY REC'G. COSTS, .5582E+06
 ANNUALIZED COST OF \$.5997E+07 WITH A YEARLY SAVING OF -.3375E+07 DROI=-128.7%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN OMAHA, NEB. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 33373.KWH/DAY AT 292.KWH/KW
 BASED ON INSOLATION OF 509.LANG./DAY, HDD/YR OF 5618, CDD/YR OF 1496.

ASSUMPTIONS

FOR A 2006START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 4.89\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	4752.SM	0.286	206.	349.	7829.	100.	475.	26.
BATTSTO.	448.KWH	0.723	0.	0.	233.	95.	43.	10.
HEAT EX.	2224.SM	0.963	349.	206.	61088.	30.	67.	0.
AUX.HTG.	8159.KW	0.750	200.	371.	71013.	12.	96.	205.
PCS	1693.KW	0.241	371.	60.	14745.	609.	1031.	206.
V.C.RFG.	1654.TON	4.500	0.	0.	42103.	471.	779.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	1940.KW	1.000	60.	19.	0.	31.	61.	0.
COOL TWR	6002.SM	0.700	60.	105.	33218.	5.	31.	0.
COLD STO	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	1895.KW	0.0	0.	0.	18656.	0.	0.	117.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=29.3% OF LOAD, UTILITY 47.0%, AND FOSSIL FUEL 82.3%
 TOTAL CAP. INV. IS \$.25836E+07 WITH YEARLY REC'G. COSTS, .5638E+06
 ANNUALIZED COST OF \$.6075E+07 WITH A YEARLY SAVING OF -.3412E+07 DRPI=-128.1%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN PHOENIX, ARIZ. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 36812.KWH/DAY AT 295.KWH/KW
 BASED ON INSOLATION OF 897.LANG./DAY, HDD/YR OF 2042, CDD/YR OF 3517.

ASSUMPTIONS

FOR A 2006START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 6.99\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	4752.SM	0.281	206.	349.	13551.	100.	475.	26.
BATTSTO.	954.KWH	0.723	0.	0.	468.	95.	91.	23.
HEAT EX.	2664.SM	0.963	349.	206.	77670.	28.	75.	0.
AUX.HTG.	9779.KW	0.750	200.	371.	85491.	10.	102.	247.
PCS	2171.KW	0.241	371.	60.	18748.	560.	1215.	231.
V.C.RFG.	2030.TON	4.500	0.	0.	57577.	435.	883.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	1384.KW	1.000	60.	19.	0.	40.	55.	0.
COOL TWR	10879.SM	0.700	60.	105.	50321.	4.	44.	0.
COLD STO	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	1925.KW	0.0	0.	0.	18134.	0.	0.	170.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=20.3% OF LOAD, UTILITY 49.0%, AND FOSSIL FUEL 71.3%
 TOTAL CAP. INV. IS \$.29401E+07 WITH YEARLY REC'G. COSTS, .6963E+06
 ANNUALIZED COST OF \$.7462E+07 WITH A YEARLY SAVING OF -.3805E+07 DRPI=-104.0%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN SEATTLE, WASH. FLOOR AREA IS 18868, SQ.M
 ELECTRICAL DEMAND IS 31330, KWH/DAY AT 317, KWH/KW
 BASED ON INSOLATION OF 418, LANG./DAY, HDD/YR OF 5329, CDD/YR OF 295.

ASSUMPTIONS
 FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 2.01\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'L D \$/UNIT SIZE	CAP. INV. K\$	REC'G K\$
COLLECT.	4752, SM	0.223	206.	349.	5020.	100.	475.	26.
BATTSTO.	116, KWH	0.723	0.	0.	30.	95.	11.	3.
HEAT EX.	1561, SM	0.963	349.	206.	49539.	35.	54.	0.
AUX, HTG.	5939, KW	0.750	200.	371.	59361.	15.	87.	171.
PCS	1188, KW	0.241	371.	60.	11958.	687.	816.	187.
V.C. RFG.	1101, TON	4.500	0.	0.	32907.	552.	608.	0.
AB, RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.
PRD, HTG.	1712, KW	1.000	60.	19.	0.	34.	59.	0.
COOL TWR	2865, SM	0.700	60.	105.	25277.	7.	20.	0.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.
AUX, ELEC	1925, KW	0.0	0.	0.	19380.	0.	0.	51.

COST ANALYSIS RESULTS
 SOLAR ENERGY FURNISHES 79.3% OF LOAD, UTILITY 41.2%, AND FOSSIL FUEL 138.1%
 TOTAL CAP. INV. IS \$.21302E+07 WITH YEARLY REC'G COSTS, .4381E+06
 ANNUALIZED COST OF \$.4741E+07 WITH A YEARLY SAVING OF -.3364E+07 DROI= -244.5%

STES EQUIPMENT SIZES FOR A LARGE RETAIL STORE
 LOCATED IN WASHINGTON D.C. FLOOR AREA IS 18868, SQ.M
 ELECTRICAL DEMAND IS 33087, KWH/DAY AT 302, KWH/KW
 BASED ON INSOLATION OF 449, LANG./DAY, HDD/YR OF 4202, CDD/YR OF 1328.

ASSUMPTIONS
 FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT=12.76\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'L D \$/UNIT SIZE	CAP. INV. K\$	REC'G K\$
COLLECT.	4752, SM	0.252	233.	349.	6083.	100.	475.	26.
BATTSTO.	31, KWH	0.723	0.	0.	7.	95.	3.	2.
HEAT EX.	2961, SM	0.954	349.	233.	73411.	27.	80.	0.
AUX, HTG.	12322, KW	0.750	228.	371.	89771.	9.	110.	259.
PCS	1892, KW	0.203	371.	110.	14872.	587.	1109.	207.
V.C. RFG.	669, TON	4.500	0.	0.	2641.	671.	448.	0.
AB, RFG.	1485, TON	0.736	108.	8.	38172.	492.	730.	0.
PRD, HTG.	1728, KW	1.000	110.	19.	0.	34.	59.	0.
COOL TWR	832, SM	0.700	110.	108.	6642.	11.	9.	0.
COLD STO	46, CM	0.700	8.	17.	0.	346.	16.	0.
AUX, ELEC	962, KW	0.0	0.	0.	9722.	0.	0.	158.

COST ANALYSIS RESULTS
 SOLAR ENERGY FURNISHES 25.1% OF LOAD, UTILITY 28.4%, AND FOSSIL FUEL 46.5%
 TOTAL CAP. INV. IS \$.30405E+07 WITH YEARLY REC'G COSTS, .6519E+06
 ANNUALIZED COST OF \$.7033E+07 WITH A YEARLY SAVING OF -.1289E+07 DROI= -22.4%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN ALBUQUERQUE, N.M. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 26866.KWH/DAY AT 187.KWH/KW
 BASED ON INSULATION OF 684.LANG./DAY, HDD/YR OF 4568, CDD/YR OF 1450.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT=10.24\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD	CST.CAP.	INV.REC'G	CST.
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE.	K\$	K\$
COLLECT.	2469.SM	0.425	141.	205.	8120.	100.	247.	13.	
BATTSTO.	5979.KWH	0.723	0.	0.	15571.	58.	348.	70.	
HEAT EX.	4588.SM	0.920	205.	141.	142027.	23.	104.	0.	
AUX.HTG.	19289.KW	0.750	135.	227.	178539.	7.	127.	389.	
PCS	2411.KW	0.167	227.	60.	23671.	540.	1302.	226.	
V.C.RFG.	2627.TON	4.500	0.	0.	78149.	393.	1033.	0.	
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.	
PRO.HTG.	3500.KW	1.000	60.	19.	0.	21.	74.	0.	
COOL TWR	12294.SM	0.700	60.	105.	87743.	4.	47.	0.	
COLD STD	0.CM	0.700	8.	17.	0.	0.	0.	0.	
AUX.ELEC	740.KW	0.0	0.	0.	3825.	0.	0.	45.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=26.9% OF LOAD, UTILITY 13.0%, AND FOSSIL FUEL 113.8%
 TOTAL CAP. INV. IS \$.32826E+07 WITH YEARLY REC'G. COSTS, .7422E+06
 ANNUALIZED COST OF \$.7978E+07 WITH A YEARLY SAVING OF -.4334E+07 DROI=-118.9%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN BLUE HILL, MASS. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 26169.KWH/DAY AT 190.KWH/KW
 BASED ON INSULATION OF 446.LANG./DAY, HDD/YR OF 5917, CDD/YR OF 655.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT=15.27\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'LD	CST.CAP.	INV.REC'G	CST.
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE.	K\$	K\$
COLLECT.	2469.SM	0.320	141.	205.	3983.	100.	247.	13.	
BATTSTO.	10487.KWH	0.723	0.	0.	37206.	55.	572.	114.	
HEAT EX.	4674.SM	0.920	205.	141.	143290.	22.	105.	0.	
AUX.HTG.	19649.KW	0.750	135.	227.	185739.	7.	128.	404.	
PCS	2456.KW	0.167	227.	60.	23882.	537.	1318.	227.	
V.C.RFG.	2476.TON	4.500	0.	0.	75013.	403.	997.	0.	
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.	
PRO.HTG.	3725.KW	1.000	60.	19.	0.	20.	75.	0.	
COOL TWR	9608.SM	0.700	60.	105.	83476.	4.	41.	0.	
COLD STD	0.CM	0.700	8.	17.	0.	0.	0.	0.	
AUX.ELEC	740.KW	0.0	0.	0.	3081.	0.	0.	57.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES 2.1% OF LOAD, UTILITY 12.1%, AND FOSSIL FUEL 85.8%
 TOTAL CAP. INV. IS \$.34826E+07 WITH YEARLY REC'G. COSTS, .8160E+06
 ANNUALIZED COST OF \$.8751E+07 WITH A YEARLY SAVING OF -.3812E+07 DROI=-77.2%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN FORT WORTH, TEX. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 27944.KWH/DAY AT 190.KWH/KW
 BASED ON INSOLATION OF 524.LANG./DAY, HDD/YR OF 2391, CDD/YR OF 2680.

ASSUMPTIONS

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, FLECT= 4.29\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	2469.SM	0.337	191.	316.	4940.	100.	247.	13.
BATTSTU.	6017.KWH	0.723	0.	0.	15201.	57.	344.	69.
HEAT EX.	3541.SM	0.957	316.	191.	109917.	25.	89.	0.
AUX.HTG.	14887.KW	0.750	185.	338.	139966.	8.	117.	305.
PCS	2538.KW	0.227	338.	60.	24981.	531.	1347.	232.
V.C.RFG.	2714.TON	4.500	0.	0.	83001.	388.	1054.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	2810.KW	1.000	60.	19.	0.	24.	69.	0.
COOL TWR	9739.SM	0.700	60.	105.	62901.	4.	41.	0.
COLD STO	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	617.KW	0.0	0.	0.	3492.	0.	0.	23.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=88.4% OF LOAD, UTILITY 13.2%, AND FOSSIL FUEL 175.2%
 TOTAL CAP. INV. IS \$.33069E+07 WITH YEARLY REC'G. COSTS, .6418E+06
 ANNUALIZED COST OF \$.6975E+07 WITH A YEARLY SAVING OF -.5006E+07 DROI=-254.3%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN LAKE CHARLES, LA. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 27876.KWH/DAY AT 194.KWH/KW
 BASED ON INSOLATION OF 447.LANG./DAY, HDD/YR OF 1264, CDD/YR OF 2603.

ASSUMPTIONS

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, FLECT= 6.22\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	2469.SM	0.278	206.	349.	3475.	100.	247.	13.
BATTSTU.	3609.KWH	0.723	0.	0.	6734.	61.	222.	45.
HEAT EX.	3270.SM	0.963	349.	206.	99363.	26.	85.	0.
AUX.HTG.	13633.KW	0.750	200.	371.	127849.	8.	114.	278.
PCS	2489.KW	0.241	371.	60.	23984.	534.	1330.	228.
V.C.RFG.	2629.TON	4.500	0.	0.	82697.	393.	1034.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	2240.KW	1.000	60.	19.	0.	28.	64.	0.
COOL TWR	7728.SM	0.700	60.	105.	57788.	5.	36.	0.
COLD STO	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	586.KW	0.0	0.	0.	4215.	0.	0.	27.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=45.1% OF LOAD, UTILITY 12.7%, AND FOSSIL FUEL 132.4%
 TOTAL CAP. INV. IS \$.31302E+07 WITH YEARLY REC'G. COSTS, .5907E+06
 ANNUALIZED COST OF \$.6434E+07 WITH A YEARLY SAVING OF -.4107E+07 DROI=-176.5%

STPS EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN LOS ANGELES, CA. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 26606.KWH/DAY AT 192.KWH/KW
 BASED ON INSULATION OF 548.LANG./DAY, HDD/YR OF 1450, CDD/YR OF 1222.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 8.84\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE.	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	2469.SM	0.333	206.	349.	5096.	100.	247.	13.
BATTSTO.	3467.KWH	0.723	0.	0.	7531.	62.	215.	44.
HEAT FX.	3141.SM	0.963	349.	206.	95453.	26.	83.	0.
AUX.HTG.	13204.KW	0.750	200.	371.	120474.	9.	113.	262.
PCS	2390.KW	0.241	371.	60.	23040.	542.	1295.	223.
V.C.RFG.	2492.TON	4.500	0.	0.	77250.	402.	1001.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	2135.KW	1.000	60.	19.	0.	29.	63.	0.
COOL TWR	6198.SH	0.700	60.	105.	54096.	5.	31.	0.
COLD STD	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	586.KW	0.0	0.	0.	3992.	0.	0.	37.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=11.0% OF LOAD, UTILITY 13.7%, AND FOSSIL FUEL 97.2%
 TOTAL CAP. INV. IS \$.30471E+07 WITH YEARLY REC'G. COSTS, .5800E+06
 ANNUALIZED COST OF \$.6313E+07 WITH A YEARLY SAVING OF -.3306E+07 DROI=-116.4%

STPS EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN MADISON, WIS. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 26108.KWH/DAY AT 188.KWH/KW
 BASED ON INSULATION OF 491.LANG./DAY, HDD/YR OF 7931, CDD/YR OF 585.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT=10.63\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'D CST. \$/UNIT SIZE.	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	2469.SM	0.324	141.	205.	4454.	100.	247.	13.
BATTSTO.	2184.KWH	0.723	0.	0.	109941.	53.	1149.	230.
HEAT FX.	4925.SM	0.920	205.	141.	152550.	22.	108.	0.
AUX.HTG.	20705.KW	0.750	135.	227.	197459.	6.	130.	430.
PCS	2588.KW	0.167	227.	60.	25425.	527.	1365.	234.
V.C.RFG.	2491.TON	4.500	0.	0.	74739.	402.	1000.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	4385.KW	1.000	60.	19.	0.	18.	79.	0.
COOL TWR	9860.SM	0.700	60.	105.	83249.	4.	41.	0.
COLD STD	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	740.KW	0.0	0.	0.	1955.	0.	0.	36.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=21.9% OF LOAD, UTILITY 9.5%, AND FOSSIL FUEL 112.5%
 TOTAL CAP. INV. IS \$.41195E+07 WITH YEARLY REC'G. COSTS, .9429E+06
 ANNUALIZED COST OF \$.1013E+08 WITH A YEARLY SAVING OF -.6080E+07 DROI=-150.2%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN MIAMI, FLA. FLOOR AREA IS 18868, SQ. M
 ELECTRICAL DEMAND IS 29029, KWH/DAY AT 203, KWH/KW
 BASED ON INSOLATION OF 518, LANG./DAY, HDD/YR OF 176, CDD/YR OF 3917.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, FLECT= 7.65\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L D CST.	CAP. INV.	REC'G CST.
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, K\$	K\$
COLLECT.	2469, SM	0.319	206.	349.	4623.	100.	247.	13.
BATTSTO.	993, KWH	0.723	0.	0.	783.	91.	90.	19.
HEAT EX.	3253, SM	0.963	349.	206.	98542.	26.	84.	0.
AUX. HTG.	13564, KW	0.750	200.	371.	125223.	8.	114.	273.
PCS	2476, KW	0.241	371.	60.	23786.	535.	1325.	227.
V.C. RFG.	2613, TON	4.500	0.	0.	87883.	394.	1030.	0.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.
PRO. HTG.	1475, KW	1.000	60.	19.	0.	38.	56.	0.
COOL TWR	7507, SM	0.700	60.	105.	61437.	5.	35.	0.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.
AUX. ELEC	586, KW	0.0	0.	0.	5296.	0.	0.	45.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=30.9% OF LOAD, UTILITY 18.5%, AND FOSSIL FUEL 112.4%
 TOTAL CAP. INV. IS \$.29811E+07 WITH YEARLY REC'G COSTS, .5761E+06
 ANNUALIZED COST OF \$.6264E+07 WITH A YEARLY SAVING OF -.3614E+07 DROI=136.4%

STES EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN NASHVILLE, TENN. FLOOR AREA IS 18868, SQ. M
 ELECTRICAL DEMAND IS 27181, KWH/DAY AT 189, KWH/KW
 BASED ON INSOLATION OF 394, LANG./DAY, HDD/YR OF 3650, CDD/YR OF 1809.

ASSUMPTIONS

FOR A 2006 START OF OPERATION. COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, FLECT= 5.99\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L D CST.	CAP. INV.	REC'G CST.
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE, K\$	K\$
COLLECT.	2469, SM	0.346	141.	205.	3805.	100.	247.	13.
BATTSTO.	4854, KWH	0.723	0.	0.	10646.	60.	291.	58.
HEAT EX.	4434, SM	0.920	205.	141.	138707.	23.	102.	0.
AUX. HTG.	18641, KW	0.750	135.	227.	179867.	7.	126.	391.
PCS	2330, KW	0.167	227.	60.	23118.	546.	1273.	224.
V.C. RFG.	2628, TON	4.500	0.	0.	79568.	393.	1034.	0.
AB. RFG.	0, TON	0.0	105.	8.	0.	0.	0.	0.
PRO. HTG.	3095, KW	1.000	60.	19.	0.	23.	71.	0.
COOL TWR	12294, SM	0.700	60.	105.	88596.	4.	47.	0.
COLD STO	0, CM	0.700	8.	17.	0.	0.	0.	0.
AUX. ELEC	740, KW	0.0	0.	0.	4550.	0.	0.	33.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=86.0% OF LOAD, UTILITY 14.3%, AND FOSSIL FUEL 171.8%
 TOTAL CAP. INV. IS \$.31905E+07 WITH YEARLY REC'G COSTS, .7191E+06
 ANNUALIZED COST OF \$.7732E+07 WITH A YEARLY SAVING OF -.5226E+07 DROI=208.5%

SYSTEM EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN OMAHA, NEB. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 26907.KWH/DAY AT 186.KWH/KW
 BASED ON INSULATION OF 509.LANG./DAY, HDD/YR OF 5618, CDD/YR OF 1496.

ASSUMPTIONS

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 5.62\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	2469.SM	0.350	141.	205.	4985.	100.	247.	13.
BATTSTO.	11446.KWH	0.723	0.	0.	38887.	55.	628.	126.
HEAT EX.	4754.SM	0.920	205.	141.	146474.	22.	106.	0.
AUX.HTG.	19985.KW	0.750	135.	227.	188649.	6.	129.	411.
PCS	2498.KW	0.167	227.	60.	24412.	534.	1333.	229.
V.C.RFG.	2662.TON	4.500	0.	0.	78332.	391.	1042.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	3935.KW	1.000	60.	19.	0.	19.	76.	0.
COOL TWR	13047.SM	0.700	60.	105.	87307.	4.	49.	0.
COLD STO	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	740.KW	0.0	0.	0.	3294.	0.	0.	23.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=81.0% OF LOAD, UTILITY 9.6%, AND FOSSIL FUEL 171.4%
 TOTAL CAP. INV. IS \$.36089E+07 WITH YEARLY REC'G COSTS, .8018E+06
 ANNUALIZED COST OF \$.8629E+07 WITH A YEARLY SAVING OF -.6003E+07 DROI=-228.6%

SYSTEM EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN PHOENIX, ARIZ. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 28678.KWH/DAY AT 186.KWH/KW
 BASED ON INSULATION OF 897.LANG./DAY, HDD/YR OF 2042, CDD/YR OF 3517.

ASSUMPTIONS

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 8.05\$/GJ(1976\$)
 RANKINE CYCLE STES, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN DEG C	TOUT DEG C	ENERGY KWH/DAY	INST'LD CST. \$/UNIT SIZE	CAP. INV. K\$	REC'G CST. K\$
COLLECT.	2469.SM	0.281	206.	349.	7041.	100.	247.	13.
BATTSTO.	5582.KWH	0.723	0.	0.	14601.	58.	324.	67.
HEAT EX.	3516.SM	0.963	349.	206.	107830.	25.	88.	0.
AUX.HTG.	14430.KW	0.750	200.	371.	134383.	8.	116.	292.
PCS	2676.KW	0.241	371.	60.	26028.	521.	1395.	237.
V.C.RFG.	2865.TON	4.500	0.	0.	86306.	380.	1089.	0.
AB. RFG.	0.TON	0.0	105.	8.	0.	0.	0.	0.
PRO.HTG.	2690.KW	1.000	60.	19.	0.	25.	68.	0.
COOL TWR	12368.SM	0.700	60.	105.	61142.	4.	47.	0.
COLD STO	0.CM	0.700	8.	17.	0.	0.	0.	0.
AUX.ELEC	586.KW	0.0	0.	0.	3198.	0.	0.	33.

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES=19.6% OF LOAD, UTILITY 12.0%, AND FOSSIL FUEL 107.6%
 TOTAL CAP. INV. IS \$.33743E+07 WITH YEARLY REC'G COSTS, .6424E+06
 ANNUALIZED COST OF \$.6992E+07 WITH A YEARLY SAVING OF -.4034E+07 DROI=-136.3%

SYSTEMS EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN SEATTLE, WASH. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 25854.KWH/DAY AT 193.KWH/KW
 BASED ON INSOLATION OF 418.LANG./DAY, HDD/YR OF 5329, CDD/YR OF 295,

ASSUMPTIONS

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT= 2.67\$/GJ(1976\$)
 RANKINE CYCLE STEAM, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L D	CST.	CAP.	INV.	REC'G	CST.
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE		K\$		K\$
COLLECT.	2469.SM	0.282	141.	205.	3300.	100.		247.		13.	
BATT STD.	4927.KWH	0.723	0.	0.	15326.	60.		298.		60.	
HEAT EX.	4428.SM	0.920	205.	141.	138589.	23.		102.		0.	
AUX.HTG.	18617.KW	0.750	135.	227.	180383.	7.		126.		393.	
PCS	2327.KW	0.167	227.	60.	23098.	547.		1272.		223.	
V.C.RFG.	2372.TON	4.500	0.	0.	73594.	409.		971.		0.	
AB. RFG.	0.TON	0.0	105.	8.	0.	0.		0.		0.	
PRO.HTG.	3080.KW	1.000	60.	19.	0.	23.		71.		0.	
COOL TWR	8272.SM	0.700	60.	105.	81886.	4.		37.		0.	
COLD STO	0.CM	0.700	8.	17.	0.	0.		0.		0.	
AUX.ELEC	740.KW	0.0	0.	0.	3412.	0.		0.		13.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES *****% OF LOAD, UTILITY 8.0%, AND FOSSIL FUEL 244.2%
 TOTAL CAP. INV. IS \$.31225E+07 WITH YEARLY REC'G. COSTS, .7017E+06
 ANNUALIZED COST OF \$.7546E+07 WITH A YEARLY SAVING OF -.5725E+07 DROI= -314.4%

SYSTEMS EQUIPMENT SIZES FOR A LOW RISE OFFICE BLDG.
 LOCATED IN WASHINGTON D.C. FLOOR AREA IS 18868.SQ.M
 ELECTRICAL DEMAND IS 26759.KWH/DAY AT 190.KWH/KW
 BASED ON INSOLATION OF 449.LANG./DAY, HDD/YR OF 4202, CDD/YR OF 1328,

ASSUMPTIONS

FOR A 2006 START OF OPERATION, COST PARAMETERS ARE
 FCR=0.159 K=0.080 G=0.050 GF=0.100 N= 20 FUEL= 2.37\$/GJ, ELECT=15.71\$/GJ(1976\$)
 RANKINE CYCLE STEAM, CONTROL BY SOLAR LOAD WITH A DISTRIBUTED COLLECTOR

EQUIP	SIZE	EFF	TIN	TOUT	ENERGY	INST'L D	CST.	CAP.	INV.	REC'G	CST.
			DEG C	DEG C	KWH/DAY	\$/UNIT	SIZE		K\$		K\$
COLLECT.	2469.SM	0.334	141.	205.	4187.	100.		247.		13.	
BATT STD.	5661.KWH	0.723	0.	0.	13155.	59.		336.		67.	
HEAT EX.	4486.SM	0.920	205.	141.	138795.	23.		102.		0.	
AUX.HTG.	18857.KW	0.750	135.	227.	179473.	7.		126.		391.	
PCS	2357.KW	0.167	227.	60.	23132.	544.		1283.		224.	
V.C.RFG.	2561.TON	4.500	0.	0.	77668.	397.		1017.		0.	
AB. RFG.	0.TON	0.0	105.	8.	0.	0.		0.		0.	
PRO.HTG.	3230.KW	1.000	60.	19.	0.	22.		72.		0.	
COOL TWR	10976.SM	0.700	60.	105.	86488.	4.		44.		0.	
COLD STO	0.CM	0.700	8.	17.	0.	0.		0.		0.	
AUX.ELEC	740.KW	0.0	0.	0.	4174.	0.		0.		76.	

COST ANALYSIS RESULTS

SOLAR ENERGY FURNISHES 0.9% OF LOAD, UTILITY 16.1%, AND FOSSIL FUEL 83.0%
 TOTAL CAP. INV. IS \$.32271E+07 WITH YEARLY REC'G. COSTS, .7703E+06
 ANNUALIZED COST OF \$.8251E+07 WITH A YEARLY SAVING OF -.3314E+07 DROI= -67.1%

76-O19-49-56B

Figure 19. Photovoltaic STES Concept for a Large Shopping Center in Albuquerque, New Mexico

3.3 SELECTED CONCEPT CONCLUSIONS

The component sizes for the selected STES configurations shown in the previous sections define the major system components for either a photovoltaic STES (Section 3.1) or a Rankine cycle thermal electric STES (Section 3.2). This data can be incorporated into Figures 3 and 9 from Section 1 to give a system flow chart as illustrated in Figures 19 and 20. Data for a photovoltaic cycle STES in a large shopping center in Albuquerque (page 38) is shown in Figure 19, while data for a organic Rankine cycle STES in a large shopping center in Albuquerque (page 76) is shown in Figure 20. The average daily loads for the system component is also available and can be added to the flowcharts as desired and illustrated on the two figures.

The selected solar thermal concepts for locations with a low relative cost of electrical energy to thermal energy cascaded the PCS energy for heating only as discussed in Volume 2, Section 5, while at locations with a high relative cost of electrical energy the selected concepts cascade the PCS energy for both heating and cooling through an absorption chiller.

For the system analyzed, the photovoltaic STES configurations appear to be most cost effective for a high escalation rate condition (which was selected for the printouts in Section 3.1 and 3.2). This is due primarily to (1) the lower operations and maintenance costs estimated for the photovoltaic systems (See Volume 2, Section 5), and (2) the assumption that reduced energy usage per kilowatt would not cause a change in the utility rate structure (See Section 5.1.2.2, Vol 2).

It should be noted that Albuquerque was found to be the best location for photovoltaic STES (see p 38) but Blue Hill was as good and was found to be better for the solar thermal STES (see p 76). Consequently, Blue Hill which represents the N.E. section of the U.S.A. is the preferred place for STES demonstrations.

76-O19-49-54E

Figure 20. Solar Thermal STES Concept (Rankine Cycle) for a Large Shopping Center in Albuquerque, New Mexico

4.0 MARKET ANALYSIS

This section describes the scope of the commercial market for STES larger than 200 kWe (study ground rule) and the projected market penetration rates for such systems. The results of the commercial building census and energy usage discussed in Sections 4.3 and 4.4 of Volume 2, show that shopping centers account for about 75 to 80% of this market. The market could be penetrated before the end of the century in certain northeastern cities (e.g., New York and Boston) which now have high electricity rates, if these cities continue to experience high escalation rates in the costs of power based on the results of Sections 2 and 3.

The results from Section 4, Volume 2 also indicate that 60 to 70% of the candidate commercial installations will be smaller than 200 kWe in size. Small unattended systems (e.g., solar photovoltaics) might become attractive for such applications at the end of this century, particularly at locations which experience high escalation rates in the price of electricity. Investigation of such systems and their applications were beyond the scope of this study and should be the subject of future investigations.

4.1 MARKET SCOPE AND PROJECTIONS

The commercial STES applications were categorized as shopping center complexes, large retail establishments, office buildings, and other buildings (including hotels and motels below three stories, warehouses, nursing homes, dormitories) as discussed in Section 4.3, Volume 2.

Data on the various segments of the commercial sector which require ≥ 200 kWe are presented in Table 1. These data were developed from the information presented in Section 4, Volume 2. As can be seen, although the shopping centers represent in the order of only 2% of the total number of units, they are relatively large aggregates for energy demand and account for 75 to 80% of the potential market for installations larger than 200 kWe in 1975, as well as that projected for the year 1990. Although annual growth rates ranging from 3 to 5% are projected for the several market segments between 1975 and 1990,^(7,8) it is assumed that the growth in capacity requirements and equivalent oil displacement

TABLE 1
PENETRABLE* COMMERCIAL SECTOR

	1975				1990†			
	No. Units	Gross Leasable Area (10 ⁹ ft ²)	Capacity (MWe)	Equivalent Oil Displacement (bbls/day)	No. Units	Gross Leasable Area (10 ⁹ ft ²)	Capacity (MWe)	Equivalent Oil Displacement (bbls/day)
Shopping Centers								
Census	18,500	2.6	26,000	560,000	39,000	5.5	42,000	900,000
Penetrable*	-	2.4	24,000	520,000	-	3.7	28,000	600,000
Office Buildings								
Census	366,000	4.3	34,000	690,000	750,000	9.2	55,000	1,100,000
Penetrable*	-	0.3	2,400	48,000	-	0.3	1,800	36,000
Other‡								
Census	365,000	6.7	22,000	550,000	560,000	10.7	26,000	670,000
Penetrable*	-	1.8	5,500	140,000	-	2.1	5,200	130,000
Total Commercial Sector								
Census	750,000	13.6	84,000	1,800,000	1,350,000	25.4	123,000	2,670,000
Penetrable*	-	4.5	32,000	710,000	-	6.1	35,000	766,000

*Greater than 200 kWe (Study Groundrule)

†Assumes implementation of ASHRAE 90-75 standards

‡Includes hotels and motels (≤3 stories, warehouses, nursing homes, etc.)

potential will be constrained by conservation measures (e.g., ASHRAE 90-75, see Section 4.4, Volume 2). Concurrently, the fraction of the market which requires systems larger than 200 kWe would be reduced significantly, particularly in the case of candidate office buildings and "other building" applications. It appears, therefore, that inasmuch as the office buildings and "other building" applications represent heterogeneous market opportunities of uncertain penetrability, it would be well to concentrate on the more "homogeneous" shopping centers for the initial demonstration program.

Data presented in Sections 2 and 3 show that the solar contribution from STES in no case exceed 55%; nominal contributions were on the order of 20 to 50%. As shown in Table 1, the total equivalent oil displacement potential in the commercial sector for STES larger than 200 kWe approximates 700,000 to 800,000 barrels per day. Assuming a solar contribution on the order of 35%, this would result in displacing 250,000 to 300,000 barrels of oil daily.

Typical data on shopping center size, distributions, and the breakeven cost of electricity as a function of peak demand (i.e., installed system capacity) are presented in Figures 16, Vol 2, and 17, Vol 3. These data, coupled with the capacity data presented in Table 1, were employed to develop a chart (Figure 21) on the cumulative market size (in MWe) for STES shopping center installation in 1990 as a function of the breakeven cost of electricity (as expressed in 1976 dollars). For example, Table 1 indicates that in 1990, shopping centers will require about 42,000 MWe, and that establishments with a demand greater than 200 kWe will represent 28,000 MWe of this requirement. To find the potential size of the market for an organic Rankine cycle at a breakeven electricity cost of \$0.10/kWh in 1990, one would interpolate in Figure 17, Vol 3, (at an escalation rate of ~8% for a start year of 1990) to find that such systems would have a capacity of at least 3 MWe, which is equivalent to a gross leasable area of some 390,000 ft² (at 7.6 W/ft²). Referring to the histogram in Figure 16, Vol 2, shopping centers of this size, or larger, now account for approximately 15% of the gross leasable area. Assuming that these distribution patterns do not change by 1990 (i.e., shape of the histogram remains the same), and that each center on the average requires 7.6 W/ft² in 1990 (as compared to 10 W/ft² now), then 15% of the 5.5 billion ft² of gross leasable area in 1990 (Table 1) will equate to about 6300 MWe of capacity.

77-MA27-55-32A

Figure 21. Cumulative Market Potential as a Function of Breakeven Electricity Cost (Nominal Scenario)

As can be seen in Figure 21, the solar photovoltaic systems appear to have a lower breakeven cost than organic Rankine systems in the smaller sized STES (also see Figure 17, Vol 3). To penetrate the 28,000 MWe represented by STES which are larger than 200 kWe in 1990 would require the cost of purchased electricity to be on the order of \$0.15/kWh, or higher (1976 dollars).

Typical state and regional monthly power costs have been compiled by the Federal Power Commission⁽⁹⁾ and are presented in Figure 22; nominal data on a number of typical sites are presented in Table 2. The breakeven power costs for a large shopping center (70,755m²) and local power costs for the candidate sites (see Section 3), plus New York City and New Jersey, are presented in Figure 23. As can be seen, New York City, New Jersey, and Blue Hill (Boston) appear to be the most attractive sites for initial penetration (i.e., when the local power costs equal or exceed the breakeven costs). It should be noted that STES commercial applications do not become attractive at these locations until sometime after the year 1986 and before 2006, and then only if the recurring costs (e.g., fuel, purchased power, operations, maintenance, etc.) escalate at an average annual rate of 10% (with a 5% general inflation rate) to the end of the project. If local electricity costs experience a significant, near-term step-increase in rates over large segments in the country and continue to escalate at high rates (e.g., 10%), STES would become more attractive sooner. Figure 24 shows the effect of arbitrarily reducing the breakeven costs by 30% (e.g., significant reduction in operating and maintenance costs, government subsidy, etc). As can be seen, the candidate sites then expand from New York and Blue Hill to also include Albuquerque, New Jersey, and Washington, D.C.

4.2 MARKET PENETRATION

Different users will move to adopt a new product at different rates. Some will purchase the new product almost as soon as it is placed on the market while others wait for additional information and rely on the experiences of the first purchasers before making trial purchases. Innovators (or first purchasers) are always likely to be present. For example, some families are first in the community to buy color television sets, while some doctors are the first to prescribe new drugs, and some farmers will use new hybrid seeds much earlier than their neighbors. Some women are quick to adopt new fashions, while some men are early adopters of new automobile designs or styles.

TABLE 9. - Weighted average bills for industrial service by geographic division - 1966, 1975 and 1976
 (Large cities only)

Geographic Division	January 1, 1976			January 1, 1975			January 1, 1966		
	150 kW	300 kW	1,000 kW	150 kW	300 kW	1,000 kW	150 kW	300 kW	1,000 kW
	30,000 kWh	60,000 kWh	200,000 kWh	30,000 kWh	60,000 kWh	200,000 kWh	30,000 kWh	60,000 kWh	200,000 kWh
New England	\$1,319	\$2,524	\$7,999	\$1,302	\$2,503	\$7,848	\$692	\$1,273	\$3,838
Middle Atlantic	1,836	3,558	11,581	1,899	3,685	11,991	788	1,445	4,320
East North Central	1,145	2,172	6,660	1,023	1,929	5,863	665	1,213	3,522
West North Central	1,016	1,973	6,106	879	1,704	5,195	633	1,151	3,430
South Atlantic	1,199	2,259	7,196	1,137	2,121	6,634	567	1,026	3,069
East South Central	883	1,698	5,099	819	1,577	4,704	447	833	2,442
West South Central	922	1,728	5,175	785	1,450	4,275	552	997	2,818
Mountain	1,033	1,953	5,900	880	1,668	5,054	565	1,057	3,048
Pacific	992	1,861	5,869	855	1,578	4,923	447	821	2,458
Noncontiguous	1,276	2,375	7,379	1,225	2,306	7,103	711	1,357	3,989
U. S. Average	1,231	2,348	7,395	1,157	2,199	6,888	631	1,154	3,407

77-MA25-55-33

Figure 22. State and Regional Monthly Power Costs

TABLE 2
NOMINAL DATA ON POWER COSTS FOR
A NUMBER OF TYPICAL SITES
(Sheet 1 of 2)

	POWER COST* (\$/kWh)**	UTILITY	POPULATION
NORTHEAST			
NEW YORK	6.73**		
MOUNT VERNON	7.98-8.30	CONS. EDISON	73,000
NEW ROCHELLE	7.98-8.30	CONS. EDISON	75,000
QUEENS	7.98-8.30	CONS. EDISON	1,987,000
RICHMOND	7.98-8.30	CONS. EDISON	295,000
WHITE PLAINS	7.98-8.30	CONS. EDISON	50,000
YONKERS	7.98-8.30	CONS. EDISON	204,000
WASHINGTON, D.C.	7.67-5.63	POTOMAC ELECT. POWER	757,000
NEW JERSEY	4.53-4.71**	PUBLIC SERV. ELECT & GAS	~7,200,000
SOUTHEAST			
GEORGIA	3.63**		
ATLANTA	3.72	GEORGIA POWER	497,000
AUGUSTA	3.72	GEORGIA POWER	60,000
COLUMBUS	3.72	GEORGIA POWER	155,000
MACON	3.72	GEORGIA POWER	122,000
FLORIDA	3.46**		
TALLAHASSEE	4.40	TALLAHASSEE, CITY OF	73,000
GAINESVILLE	3.90	GAINESVILLE-ALACRUA CO REV	65,000
CLEARWATER	3.63	FLA. POWER CORPN	52,000
JACKSONVILLE	3.64	JACKSONVILLE ELECT AUTH.	529,000
ST. PETERSBURG	3.63	FLA. POWER CORPN	216,000
TAMPA	3.66	FLA. POWER & LIGHT	278,000

*BASIS: 200,000 kWh/MONTH
1000 kW DEMAND

**STATE AVERAGE (\$/kWh)

77-J17-9-15

TABLE 2
NOMINAL DATA ON POWER COSTS FOR
A NUMBER OF TYPICAL SITES
(Sheet 2 of 2)

	POWER COST* (¢/kWh)**	UTILITY	POPULATION
WEST			
ARIZONA	3.58**		
MESA	3.35-3.65	SALT RIVER PAI POWER DIST.	63,000
PHOENIX	3.40-3.70	SALT RIVER PAI POWER DIST.	582,000
SCOTTSDALE	3.35-3.65	SALT RIVER PAI POWER DIST.	68,000
TEMPE	3.35-3.65	SALT RIVER PAI POWER DIST.	64,000
TUCSON	4.36	TUCSON GAS & ELECT.	263,000
CALIFORNIA	3.16**		
SAN DIEGO CO.	4.35-4.71	SAN DIEGO GAS & ELECTRIC	~697,000
HAWAII	4.06**		
HONOLULU	4.06	HAWAIIAN ELECTRIC CO	325,000
KAILUA	4.06	HAWAIIAN ELECTRIC CO	34,000
KANEOHE	4.06	HAWAIIAN ELECTRIC CO	30,000

*BASIS: 200,000 kWh/MONTH
1,000 kW DEMAND

**STATE AVERAGE (¢/kWh)

77-J17-9-14

77-MA25-55-24A

Figure 23. Breakeven Electricity Cost vs Local Electricity Cost

77-MA25-55-24B

Figure 24. Breakeven Electricity Cost vs Local Electricity Cost

A number of investigations analyzing the adoption of new products have resulted in the identification of five categories of purchasers based upon relative time of adoption. These are shown in Figure 25.⁽¹⁰⁾

The diffusion process is depicted as following a normal distribution. A few people adopt at first, and then the number of adopters increase rapidly as the value of the innovation is apparent. The rate finally diminishes as fewer potential consumers remain in the nonadopter category. Since the categories are based on a normal distribution, standard deviations are used to partition each category. Innovators are defined as the first 2.5% of the individuals to adopt the new product; laggards are the final 16% to adopt. Excluded from Figure 25 are the nonadopters (i.e., persons who never adopt the innovation).

Mansfield⁽¹¹⁾ and Schon⁽¹²⁾ have shown that the adoption of new technologies by industrial firms varies from industry to industry. Fisher and Pry⁽¹³⁾ have investigated the substitution of new commodities and found that the time from 10% to 90% adoption ranges from 5 years (substitution of detergent for soap) to 58 years (substitution of synthetic rubber for natural rubber). New innovations in the building industry have been reported to range from 30 to 50 years.⁽¹⁴⁾

The commercial solar total energy system market is expected to consist of two segments — the new and retrofit market. The new market can be expressed as a fraction of the existing inventory or potential retrofit market. It is expected that new construction will be coupled to demographic patterns and the rate of retirement of older or uneconomic installations. Based on data presented by the Solar Energy Industries Association,⁽¹⁵⁾ it is anticipated that the annual new construction market will range between 2.5 and 5.0% of the total inventory. In practice, it is expected that STES penetration of both the new and retrofit sectors will be a function of return-on-investment (or the magnitude of the difference between the cost of conventional energy sources and the breakeven cost as defined earlier), the availability of conventional energy sources, and the "capturability" of new construction (e.g., as constrained by possible restrictions on the use of STES).

The census of the retrofit market — 20 to 40 times greater than the new construction market — is dynamic. The population grows by the addition of new buildings which did not have solar equipment installed when they were built, and

77-MA25-55-23

Figure 25. Time for Adoption of a New Product
(Historical Diffusion Curve)

shrinks by the destruction of old buildings and prior retrofits. The actual number of retrofit candidates, therefore, varies annually. "Capturability" of these buildings depends not only on the criteria cited for new construction but also on the adaptability of solar systems to the existing heating, ventilating and air conditioning (HVAC) system, building orientation, expected life, setbacks and shadows from neighboring structures, etc. Based on the data in Reference 15, a capture level on the order of 1% has been assumed for retrofits.

It is further assumed that the decision to install a solar energy system will be made on the basis of the anticipated return-on-investment (ROI) as compared to the ROI for a conventional installation. Different scenarios can be developed which consider:

- 1) ROI comparisons to a conventional installation.
- 2) The impact of government stimulation in the form of income/investment tax credits, low-cost loans/loan guarantees, etc.
- 3) Threatened unavailability or potential curtailment of conventional energy sources which would dictate the adoption of energy alternatives (i.e., solar), and result in some compromise in ROI objectives in order to "stay in business."

In no case, however, can initial penetration be assumed to occur until the STES installation achieves the minimum ROI or breakeven criteria. These criteria may be:

- 1) Nominally, the utilities like to maintain a 12 to 15% return on equity (or the incremental investment on the solar-related components) and the investor-owner will require at least 15 to 20% return (assuming that the decision maker's assessment indicates that a solar system does not imply a higher risk than a conventional system). Given that the other factors in the "weighted after-tax cost of money" equation (Appendix G, Volume 4) remain the same (i.e., tax rate, bond and preferred interest rates, debt to equity ratio, etc.) and the amortization period, insurance rates, etc., do not change, then the breakeven costs presented in the previous sections of this report will prevail.

- 2) The "minimum breakeven criterion" would be one where the "cost of money is reduced by the STES buyer lowering his ROI objectives to stay in business or the availability of government stimulants in the form of tax credits, low-cost loans, etc. Typically, if the "cost of money" were reduced from the nominal 8 to 4% by a combination of reduced ROI objectives, low-interest loans, and/or income tax credits, the breakeven costs would be reduced by about 25 to 30% and earlier initial market penetration could be achieved. Once the breakeven criterion is met, market penetration will proceed at a rate which is proportional to the incremental return on the solar investment (over, and above, the ROI criterion selected).

It can be shown that the new penetration rate can be approximated by

$$\begin{array}{ll} \text{Cumulative Penetration} & \sim [(1 + P)^n S - 1] \\ \text{Prior to "Saturation"} & \end{array}$$

$$\begin{array}{ll} \text{Cumulative Penetration} & \sim S (n - n_s) \\ \text{After "Saturation"} & \end{array}$$

where

P = cumulative penetration rate/year

n = years

n_s = years to reach "saturation" fraction

S = "saturation" fraction = fraction of market captured

Figure 26 shows the discrete market diffusion rate characteristics for new and retrofit construction based on the relationship describing penetration prior to "saturation." For example, assuming a 1% per year penetration rate for the retrofit market segment⁽¹⁵⁾ shows that it will take about 20 years to achieve about 20% penetration (cumulative). In the new construction market, if penetration proceeds at the rate of 2.5% per year,⁽¹⁵⁾ it would take nearly 20 years (after initial penetration) to achieve approximately 60% cumulative penetration. Thus, the combined new construction and retrofit market penetration would be about 80% cumulative after 20 years for the above example.

77-MA25-55-20

Figure 26. Discrete Market Diffusion Rate Characteristics
(Retrofit and New Construction)

The total market census is comprised of the new construction plus the retrofit segments. At the "saturation" point for new construction there will be significant increase in the penetration rate so that estimation of the elapsed time before this occurs is of interest. The time to reach the "saturation" point is given by rearranging the relationship describing penetration prior to saturation or

$$n_s = \frac{\ln(1 + S)}{\ln(1 + P)}$$

Figure 27 shows series of typical combined diffusion rate curves for both the retrofit and new construction market segments. Assumptions included a retrofit market contribution of 1% per year and an annual new construction rate equal to 5% of the inventory.

The curves follow the classic Fisher-Pry diffusion curves.⁽¹³⁾ Assuming a 2.5% per year new construction market penetration rate, it will take 30 years to penetrate about 55% of the total market; if the new construction penetration rate approaches 20% per annum, 90% saturation would be achieved in slightly over 18 years.

Figure 28 is a cross plot of the data in Figure 27 and shows the time required to achieve 30% and 90% market penetration as a function of the annual new construction penetration rate and new construction rate (i.e., percent of inventory). It should be noted again that the overall penetration rate, particularly for new construction, will be a function of the incremental ROI; the project start year (year zero) will occur when the minimum ROI, or breakeven criteria, are met.

4.3 MARKET ANALYSIS CONCLUSIONS

In summary, therefore, limited initial market scope and projection analyses indicated that there will be a commercial market for systems ≥ 200 kWe of some 35,000 MWe in 1990. Although they represent only 2% of the total number of potential commercial units, shopping centers will account for some 75 to 80% of the potential market. Initially, this market might be penetrated in the north-eastern region of the U.S. (e.g., New York, Boston, and Washington, D.C.) which now has the highest electricity costs, if recurring costs (e.g., operations,

77-MA25-55-21

Figure 27. Typical Diffusion Rates
(New Construction Plus Retrofit)

77-MA25-55-22

Figure 28. Effect of New Construction Penetration Rates on Time to Achieve Adoption

maintenance, fuel, etc.) continue to increase at a "nominal" rate of some 8% annually. In large systems (e.g., ≈ 1 MWe) the organic Rankine STES exhibits a lower breakeven cost of electricity than photovoltaic systems. Below 1 MWe peak capacity, the lower operating and maintenance cost associated with photovoltaic systems make them more cost effective.

An analytical method has been developed to estimate the market penetration rates. Assuming an annual new construction rate equal to 2.5 to 5% of the existing inventory and a progressively compounded new construction penetration rate of 5% per year coupled with a retrofit penetration rate of 1% per year, it can be shown that it will take 20 years to penetrate 50% of the potential market and 25 to 35 years for STES to achieve 90% adoption in the classic Fisher-Pry diffusion manner.

Figure 29 shows the penetration potential, expressed in quads (i.e., 10^{15} Btu), as a function of time. It should be noted that, as shown in Section 3, it is unlikely that the solar contribution will account for more than 50% of the energy requirements.

	RETROFIT PENETRATION RATE (%/yr COMPOUNDED)	NEW CONSTRUCTION PENETRATION RATE (%/yr COMPOUNDED)
SCENARIO I	1	2.5
SCENARIO II	1	5.0

ANNUAL NEW CONSTRUCTION IS 5% OF INVENTORY

Figure 29. Commercial Sector Market Penetration Potential by STES

5.0 PROJECT UTILIZATION PLAN

One of the stated objectives of the National Solar Energy program was to assist in the development of a viable solar energy industry. The purpose of the Project PUP is to provide a path leading to the earliest demonstration of STES as a foundation for establishment of an STES industry base. Demonstration projects are being used as the method to bring this about. Therefore such demonstrations must respond to the needs of potential manufacturers and buyers for technical and economic data on which to make decisions leading to extensive commitment of capital.

As envisioned here an STES Demonstration Plan for Commercial Applications must include several cycles using a variety of buildings, sites and experimentally-proven STES concepts. This PUP is similar to DOE's current nonresidential solar heating and cooling demonstration program. It encompasses the Demonstration Plan but is broader in nature, it thus involves peripheral but essential activities in marketing, codes, legislation, utilities interface and technology development. A logic for the plan is given in Figure 30.

The program starts with existing technology to provide one or several demonstrations in locations and buildings of primary interest for the commercial section. Large retail stores located in shopping centers are preferred. Full shopping centers and, as a special case, office buildings would also be considered. Successive cycles would include new, more sophisticated technology. However, a key factor in the PUP is that each Solar Total Energy Demonstration (STED) must be preceded by a Solar Total Energy — Large Scale Experiment (STE-LSE) wherein the demonstration system has undergone proof-of-concept testing.

Since implementation schedules for demonstrations are relatively short compared to those for development of large building projects, demonstrations will tend to be retrofit, probably on buildings of recent construction. During design phases advantage would be taken of information from other solar energy utilization programs as it becomes available. Later cycles would continue to conduct demonstrations of advanced technology until a commercial industry-wide base for STES is firmly established. More advanced systems will be an ever-increasing part of the demonstration program. As an example, technology developed from DOE-funded

Figure 30. Project Utilization Plan Logic

component R&D might provide new refrigeration (freezer application) absorption cycles which would open the supermarket area to STES. Central receiver technology resulting from the 10 MWe central tower power station might find application to on-site systems. In any event, the STES program is not planned to culminate in a single demonstration or even several demonstrations in a single phase but to continue in providing the gradual and orderly takeover of STES supplied by industry. This can take place once performance data justifying STES economics are demonstrated.

5.1 DEMONSTRATION PROJECT SELECTION CRITERIA

In Section 4, Volume 2 requirements were established for STES to meet the potential needs of the U.S. commercial applications as represented by a number of model building configurations candidate sites. In this section, the primary concern is selecting candidate sites which are suitable for demonstrations. These may or may not be from among the sites previously considered. First of all, it would seem logical to select demonstrations in areas and on sites where conditions are most favorable to employ STES. A list of criteria are given in Table 3 which are suggested for use in the evaluation. Most important criteria are those which deal with the willingness of the various participants and peripheral groups to share in the burdens of the demonstration. An attitude of cooperation between the owner/operator, manufacturers, installer, consultants, utilities, and government has proven to be essential to the timely conduct of successful solar heating and cooling demonstrations. Considering the greater complexity and cost of STES, and the greater involvement of groups such as local building departments and utilities a congenial atmosphere will be important, if not essential, to conducting a successful STES demonstration.

Tradeoff studies in Section 2 show the strong dependency of fuel prices in determining favorable STES economics. Studies by others have shown similar sensitivity for solar heating and cooling. Fuel prices are not given top priority here for two reasons. First of all there is large uncertainty in price projections. Secondly it is the feeling of some that prices will tend to normalize to a greater degree as shortages become more acute and government permits more of the prices to be set by the marketplace.

TABLE 3

STES DEMONSTRATION SITE/APPLICATION EVALUATION CRITERIA

Item Number	Description	Effect	Relative Ranking
1	Building Availability	Some preferred sites may not have suitable buildings	1 (high)
2	Owner's attitude }	{ Owner and utility cooperation is essential to projects success	1
3	Attitude of utility }		
4	Legacy	System and application must have wide market application	1
5	Degree of owner's exposure	Will effect owner's attitude	1
6	Visibility	Will influence early acceptance	1
7	Cost share/projected savings	Will influence contractor capture potential	2
8	Direct insolation available	Power generating capacity, capital \$/kW	2
9	Peak demand/average demand	Utilization, capital \$, utility peak	2
10	Peak demand	Solar capital cost or utility peak demand	2
11	Electrical demand	Scale effects, \$/kW and \$/kWh	2
12	Electrical/thermal demands	Overall efficiency/cost effectiveness	2
13	Fuel availability	May permit premium \$ for solar	2
14	Likelihood of severe storm	Insurance rates	2
15	Fire and safety	Acceptance by required agencies — public	2
16	Total area/load demand	Solar fraction provided by STES	2
17	Coincidence of insolation with demand	Storage requirements or utility peak demand	3
18	Secondary peak	Off season peak, heating requirements	3
19	Primary fuel cost }	{ Important economic factors but impossible to predict with accuracy	3
20	Secondary fuel cost }		
21	Roof structure	Important for retrofit	3
22	Roof area/load	Important for economics	3
23	Utility rate	Storage size, but ratchet can change	3
24	Code restrictions	May require variance	3
25	Labor restrictions	Economics	3
26	Control-load service quality	Cost	3
27	Aesthetics	Acceptance by owner	3
28	Degree days cooling	Minor in most cases	5 (low)
29	Degree days heating	Minor in most cases	4
30	Mass of building	Environmental effects — relatively small	4
31	Humidity	Regional and seasonal load variations	4

Most of the criteria given in Table 3 are difficult to quantify. However, they provide guidelines for an evaluation in which qualitative site-peculiar characteristics such as climate, local building regulations owners attitude may be overriding considerations.

5.2 USER REQUIREMENTS

As discussed in Appendix B, Volume 4 many discussions have been held with builders, owners/ operators and with consultants involved in large commercial buildings or retail chain stores.

The following comments are indicative of attitudes generally held by responsible managers in large U.S. retail chain stores and shopping centers. A basic assumption made is that the STES would be cost effective for the application considered.

- 1) A STES demonstration is a unique and complex undertaking presenting problems which are unique to the locale and the attitudes of various regulatory and pressure groups. Much effort, perhaps a test case, is required to obtain definitive answers on constraints which may be imposed.
- 2) Department stores in the order of $13,940 \text{ m}^2$ to $23,234 \text{ m}^2$ ($150,000$ to $250,000 \text{ ft}^2$) provide the most attractive STES demonstration market. These would probably be anchor stores in a shopping center, and not stand-alone stores.
- 3) Next in order would be medium to large shopping centers.
- 4) Office buildings of reasonable size and configuration for STES do not constitute a significant market compared to other commercial applications.
- 5) Supermarkets provide a large and well-defined potential market but about 50% of the load is refrigeration (freezers) which requires further technology advancement for thermally operated (absorption) chillers.
- 6) Licensed operators will normally be required for systems involving steam at 15 psi or greater or water at 250°F or greater.

- 7) The use of flammable or toxic fluids will be largely prohibited unless attitudes, codes, etc., are changed.
- 8) Because of timing, the demonstration will probably be a retrofit installation.
- 9) Owners are very reluctant to act as a prime contractor to the government or to come under the boiler plate contract provisions. However, they would permit (and in some cases actively participate) in a demonstration if some other technical firm ran the program and handled the government interface. Owners of large retail chains may be receptive to cost sharing.
- 10) Developers often have access to more sophisticated engineering staffs but often do not have a long-term commitment to own and operate once a shopping center is built.
- 11) The South is favored for demonstrations. Restrictions are fewer and growth is more rapid.
- 12) Commercial people have no interest in technology as such unless it will increase profits. The same can be said for the "innovator image." "A STES on the roof won't sell more carrots."
- 13) Commercial profit margins are small — from 1% in food retailing to 3.3% in department stores based on gross sales. This is an essential consideration in determining the acceptability of STES or any other capital-intensive situation.
- 14) There are always new stores being built or old ones being renovated in every area of the country. Many suitable facilities can be found for demonstration projects.
- 15) Every large commercial company has an active energy conservation program and seems to be interested in solar energy utilization potential. However, skepticism is high that it would provide relief in the near (five year) term. Beyond that there is little interest except by large developers — even then not for demonstration but for application.

- 16) Space heating is of minor concern even in cold climates. The exception is in nonrefrigerated warehouses which are generally heated and seldom cooled.
- 17) Firms have built, funded studies, or have active plans to incorporate solar space conditioning.

In summary, STES requirements for demonstration projects were found to be quite uniform. Potential users appear programatic and will become involved in STES installation when it becomes an economically sound business decision to do so. Legislation and/or the unavailability of conventional energy sources would have an impact in the decision making process.

5.3 TECHNOLOGY REQUIREMENTS

It is possible using equipment available today to assemble an operational STES. Such a system is already in operation at part-load by Sandia Laboratories in Albuquerque, N.M. The economic feasibility of STES, however, would be considerably enhanced by reduction of the operation and maintenance (O&M) costs of the systems. As discussed in Section 2, the estimated O&M costs for both the Rankine and photovoltaic STES need to be reduced to improve the cost effectiveness of STES for commercial buildings. The reduction in building demand loads expected from energy conservation measures will also increase the need for reduced O&M costs since the installed system sizes may be considerably smaller than that analyzed during this study. Improved performance and decreased costs are, of course, needed for all STES components; however, emphasis should be placed on developing equipment with low O&M costs. Further studies on STES concepts (such as the Brayton cycle) are needed to assess their potential for reducing the system O&M costs. Fossil-fired Brayton cycles have been successfully used for unattended high reliability power generation and should also have low O&M costs in STES application.

Development of an advanced collector design suitable for use with the low pressure Brayton cycle should be investigated to determine feasibility in this small size range.

Component level performance improvement is always desirable, but must not be at the expense of complexity which almost always increases O&M costs.

Photovoltaic STES can reduce system O&M costs and appear attractive for commercial building applications. The primary breakthrough required is in the reduction of photovoltaic systems costs.

Although not considered in this study, the small low pressure reciprocating steam engine should also be evaluated for a power conversion system in STES as a potential solution to the high O&M costs of systems in this size range.

5.4 INSTITUTIONAL CONSTRAINTS

As discussed elsewhere, constraints exist in the form of codes, standards and practices which will restrict the application of STES. Pressure groups such as those of environmentalists and homeowners can be expected to develop, particularly if STES are not well conceived aesthetically as well as technically. An essential part of a successful PUP must be the development of public support for STES well in advance of detailed design for a specific application. Each demonstration project will constitute a test case for overcoming institutional and general opposition. This aspect of "selling" the concept is every bit as important as the more technical and economical aspects of the problem.

Once a group of candidate sites is selected, including potential users, discussion should be held with local officials and citizens groups to stimulate interest and acceptance. These meetings must be low-key and well supported by background information. Local, respected, consulting architectural and engineering firms must be involved from the beginning and, ideally, would be the ones who truly sell the program. An active public information effort will be an important part of the demonstration program from start to finish. This will include emphasis on technical data dissemination with the objective of stimulating market demands and resulting solar energy industry response.

5.5 UTILITY INTERFACE

The scenarios involving STES interfaces with the utilities can take a variety of forms. This interface is more critical in the STES case than for other applications of solar energy because it is in direct competition with electric utilities and it is the most sensitive to available insolation. The U.S. commercial sector is predicted upon the basis of the availability of electric power as

being almost universally available and almost exclusively generated by public regulated utilities. It seems safe to say that this situation will not change in the foreseeable future. Utilities are already involved in their own solar energy programs. As one manager of a large utility stated during discussions "If STES is good business, we'll be in it."

Recommended Approach

The overall objective of the STED program is to develop sufficient confidence in STES that a viable self-sustaining commercial market will develop. This requires design, construction, test and evaluation of marketable STES in sufficient numbers and for a sufficient period of time that factual data are developed on life cycle performance and cost. By "marketable" is meant systems which can be placed on the market without substantial development and which meet the needs of a substantial share of potential buyers.

It is assumed that, at the time the STED program is implemented, system concepts for STE-LSE have already been selected and that construction is imminent. The selection of these concepts will have considered market applicability.

The next step is to identify candidate sites based upon the criteria of Section 5.1 or similar. As previously discussed, the primary criteria are:

- 1) A suitable facility
- 2) A suitable solar climate
- 3) A suitable cost effective STES concept
- 4) A cooperative owner/user
- 5) Support of local officials, consultants and the populace.

The last two factors are nontechnical and require extensive ground work at the beginning and continuing throughout the program.

As preliminary and definitive design phases are undertaken, data should become available from other solar energy projects which may influence system configuration. The further STED program proceeds, the more influence these data should have on improving STED system design over that of the supporting STE-LSE.

Figure 31. STED Work Breakdown Structure

Since there are considerable variations, both in potential user requirements and in promising STES, a demonstration program is envisioned which would progress through several cycles using successively improved systems and higher levels of technology.

The culmination of the STED will be fulfillment of the previously stated objective when industry begins to develop the STES market on its own.

5.6 WORK BREAKDOWN STRUCTURE (WBS)

The WBS of Figure 31 shows major tasks common to each of the sites which may be selected for a STED. It is assumed that preliminary design and institutional activity would begin simultaneously once a particular site is selected. Each system candidate to be considered will be supported by sufficient data by virtue of its STE-LSE counterpart to permit an accurate, detailed evaluation in relation to site requirements. As the final task, turnover will be accomplished whenever the owner accepts responsibility for full operation and maintenance of the system. The preliminary design task generally would include the following.

Preliminary Design Task Description

- 1) Site Requirements - Determine energy requirements, both thermal and electrical, power regulations, control; structural, mechanical, electrical interfaces. Recommend and implement energy conservation measures.
- 2) Climatology - Develop a data base of site weather and insulations for use in system selection, evaluation and control strategy studies.
- 3) System Selection - From among the (limited) number of STE-LSE systems available, supply evaluation criteria and select STED system most compatible with site requirements.
- 4) System Requirements - Based on trade-offs determine type, size, and operating conditions for system components. Prepare design specifications for integration with building requirements.
- 5) Performance Predictions - For the range of conditions expected at the site, investigate control strategies and determine probable range of system performance in times of backup energy requirements.

- 6) Cost Estimate - Prepare cost estimates in support of budgeting requests for the remainder of the program.
- 7) Economic Analysis - Perform full cycle cost analysis to determine probable benefits to owner as background for cost-sharing negotiations.

In a new technology area, such as STES, acceptance by the majority of users will not occur until some time after the first users (innovators) have demonstrated the feasibility of the concepts. Demonstration programs which would follow the large side experiments (LSE) now planned would serve this purpose and provide a hardware construction base as well as a utilization of technology demonstration. These programs could be used to reduce the investment risk in manufacturing solar systems by assuring a reasonable market size during the early growth period.

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LIST OF SYMBOLS

$A, a, b, B, C_1, C_2, C_3$	Equation constants	T_{cnd}	Condenser temperature
A_a	Absorber area that is illuminated	T_{ci}	Collector inlet temperature
A_c	Collector area	T_{co}	Collector outlet temperature
A_r	Absorber area that radiates	T_{ei}	Heat exchanger inlet temperature
A_x	Heat exchanger area	T_{eo}	Heat exchanger outlet temperature
C, C_p	Specific heat	T_{cs}	Cold storage temperature
CEL	Coefficient of heat generation from electrical lighting	T_{ct}	Cooling tower temperature
CF	Cloud factor	T_{mn}	Monthly minimum air temperature
CHD	Coefficient of process heat	T_{mx}	Monthly maximum air temperature
CHL	Coefficient of heat loss	T_{sp}	Building internal temperature setpoint
CN	Cloud number	T_t	Turbine inlet temperature
CRL	Coefficient for humidity effects	U	Overall heat transfer coefficient
CVH	Coefficient of heating ventilation	V_{sm}	Single media fluid volume
CVR	Coefficient of cooling ventilation	w	Fluid mass flow rate
COP	Coefficient of performance	W_c	Collector (heliostat) width
D	Diameter	W	Weight
dr	Decomposition rate of oil	X	E-W collector (heliostat) spacing
E-W	East-West	x	Quality
EL(t)	Fraction of maximum electrical as a function of time	Y	N-S collector (heliostat) spacing
F_o	Eigenfunction of matrix temperature	y	Distance coordinate
g_c	Gravitational constant	y_d	Submersion depth of diffuser
h	Solar hour angle	<u>GREEK</u>	
HL(t)	Fraction of maximum process heat as a function of time	α, β	Insolation constants
H_{DN}	Daily total direct normal insolation	α	Absorptivity
H_h	Daily total horizontal insolation	B	Solar cell temperature loss coefficient
I_c	Solar constant	γ	Specific heat ratio
I_1, I_2, I_3	Insolation integrals	ϕ	Solar declination angle
I	Direct insolation	ϵ	Void fraction of matrix material
I_{DN}	Direct normal insolation	ϵ_c	Emissivity
I_h	Total horizontal insolation	n	Efficiency
J	Mechanical equivalent of heat	η_{pcs}	Power conversion efficiency
k	Thermal conductivity	η_{st}	Storage tank thermal efficiency
L	Length	η_{oc}	Optical efficiency
L_c	Collector (heliostat) length	μ	Viscosity
MTD	Mean temperature difference	ρ	Density
N-S	North-South	σ	Stefan-Boltzman constant
N_{Nu}	Nusselt number	τ	Transmissivity
n^*	Day of year	Δ	Incremental change
N_{pr}	Prandtl number	<u>CAPITAL</u>	
N_{re}	Reynolds number	O_a	Solar azimuth
OL(t)	Fraction of maximum occupancy load	O_E	Solar elevation angle
p	Wetted perimeter	O_z	Zenith angle
PP	Percent possible sunshine	ϕ	Site latitude
P	Pressure	<u>ECONOMIC PARAMETERS</u>	
Q	Energy	AC	Annualized cost
q	Heat transfer rate	BECE	Break-even cost of electricity
Q_{BS}	Battery electrical storage energy	CI	Capital investment
Q_{CS}	Cold thermal storage energy	CRF	Capital recovery factor
Q_{ED}	Electrical load demand	FCR	Annualized fixed charge rate
Q_{HD}	Heat load demand	g	General inflation
Q_{HS}	Hot thermal storage energy	g_f	Fuel escalation rate
$(q/A)_{ins}$	Insulation heat transfer loss rate	k	After tax cost of money
Q_{RD}	Cooling load demand	n	Power law exponent
Q_T	Maximum load constant for building	N	Number of years of system life
Q_{use}	Usable heat transfer rate	NO	Number of units
R	Solar distance ratio	OPM	Recurring cost - electricity cost
R_c	Cycle efficiency ratio	p	Years to start of operation
r	Reflectivity	RCC	Recurring cost
τ	Collector tilt angle	R O I	Return on investment
$\bar{T}$	Average temperature	Y_{co}	First year of operation
t	Time	<u>Subscript</u>	
t_L	Building heating lag time	pv	Present value
T_{cell}	Temperature of solar cell	o	Original building
T_{ref}	Reference temperature of solar cell (nominally 28°C)	STES	Solar total energy system
T_a	Ambient temperature	max	Maximum