

CHAPTER 1. LIFE-CYCLE COST ANALYSES OF UTILITY COMBINATIONS

1-1. PURPOSE.

- a. To analyze the utility system of a proposed new construction/substantial rehabilitation public or Indian housing development.
- b. To evaluate the cost-effectiveness of a passive/active solar system in public or Indian housing development projects.

1-2. AUTHORS AND APPLICABILITY

- a. The legal and regulatory authority for life-cycle cost analysis of utility combinations are as follows:

(1) U.S. Housing Act of 1937, as amended in 1979 (Section 13, P.L. 96-153 dated 12/21/79).

(2) U.S. Housing Act of 1937, as amended in 1980 (Section 5(i), P.L. 96-399 dated 10/8/80);

(3) 24 CFR 941.404;

(4) 24 CFR 968.115(d);

(5) 24 CFR 950.603(d).

b. APPLICABILITY.

(1) The U.S. Housing Act of 1937, as amended, (the Act) requires that, to the maximum extent practicable, newly constructed and substantially rehabilitated developments assisted under the Act be equipped with heating and cooling systems selected on the basis of criteria which include a life-cycle cost analysis of such systems. The Housing and Community Development Act of 1980 requires these developments to be equipped with a passive or active solar energy system that would be cost effective over the estimated life of the system to be installed.

(2) Public Housing Agencies and Indian Housing Authorities (HA) must complete a Life-Cycle Cost Analysis of Utility Combinations (LCCAUC) for proposed new developments and developments which are to be substantially rehabilitated. HAs replacing utility systems with either modernization or other funding are also required to complete a LCCAUC. The LCCAUC must be based on criteria which include installation costs and long term operation and maintenance costs.

(3)HAs may use data and procedures that they have developed as long as elements stated in 1-2.b.(2) above are included in their analysis. Energy savings for solar energy systems should be calculated in accordance with recognized industry procedures.

(4)Alternatively, HAs have the option to use the procedures and methodologies of this Handbook. If a HA prepares an analysis using the procedures and methodologies of this Handbook, all the provisions of this Handbook should be followed. The data contained herein is based on national averages which may not be applicable to a particular locality or housing project. Therefore, the data contained herein should be considered as a guide only and should be adjusted to fit local conditions. *

1-3. UTILITY SELECTION.

- a. The selected utility combination must provide safe and adequate service at the lowest life-cycle cost. This selection must be made in the planning stage of a project.
- b. Considerations in selecting a utility combination:

(1) A substantial portion of the operating expenses of a multifamily housing project is the expense of providing lighting, refrigeration, cooking, domestic hot water, space conditioning, water and sewage disposal services.

5/95

Page 1-1a
7418.1 CHG-1

(2) Construction costs may be materially influenced by the choice of utilities for such items as central heating plants with distribution lines, fuel storage and handling facilities and chimneys.

(3) A utility system's quality, dependability, space requirements, maintenance, comfort potential, environmental impact and energy conservation. For example, two types of space heating systems might be vastly different in these characteristics but still have nearly equal total annual owning and operating costs.

7418.1
Page 1-1b

5/95

(4) Systematic analysis of costs must be made because of

the large number of possible combinations of fuels, energy, purchasing methods, types of installations and utility rate schedules. For example, gas may be used for any single or a combination of the following functions: cooking, domestic hot water and space heating. Each combination will require different facilities and equipment and may change the operating costs due to applicable rate schedules and methods of purchase. In comparing combinations of utilities, it is the relative differences rather than the absolute dollar amounts that are significant.

1-4. PRINCIPLES OF UTILITY PLANNING AND EVALUATION.

- a. The analysis must include all feasible types of fuel/energy and methods of utilization, distribution, and purchasing that are available in the area.

- (1) The data must show initial and monthly costs for both individual dwelling unit and project operated heating plants, where each type is feasible. The monthly costs must include both those costs which would be paid by the tenants and those paid by the PHA/IHA.

- (2) The analysis must show the total relative costs for the various utility services, including water and sewage disposal, whether purchased and paid for directly by the tenant (retail basis) or purchased by the PHA/IHA and included in the rent (master metered).

- (3) A large number of utility combinations is theoretically possible. However, only those which are reasonable and practicable where the project is to be developed should be evaluated.

- (4) Where an analysis has been prepared for a prior project of similar size and condition, it is not necessary to prepare a new analysis for the proposed project. Instead, the prior analysis may be used by reference. However, it should be verified that the utility and escalation rates used in the prior analysis represent current conditions and forecasts.

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- b. The analysis of utility costs should include the following elements, when feasible:

- (1) Fuel and energy;

- (2) Fuel and energy price escalations;

- (3) Operating labor (project operated heating and air

conditioning plants);

(4) Repair and maintenance;

(5) Replacements of equipment and facilities;

(6) Initial costs of utility systems and the interest rate used in the Annual Contributions Contract (ACC).

c. In addition to the factors that can be calculated, there may be convenience factors which may be important in a particular situation and should be considered.

d. In applying such rates to master-metered service, all provisions that affect costs including taxes, adjustments and other clauses must be included to compute costs correctly.

(1) To maximize the benefits of a master metered rate, the rate should be applied to the estimated total project consumption.

(2) Where project size or the distribution system design requires more than one delivery point, the local utility company should be requested to combine readings and apply conjunctive billings.

e. A nominally lower master-metered rate could be negated by excessive tenant consumption unless there is monitoring beyond the master meter;

(1) An equitable and effective way to control tenant utility consumption is to install a checkmeter for each dwelling unit and surcharge tenants for excessive consumption.

(2) In making the determination to purchase a utility service through a master meter, the cost of the installation and the maintenance and management of checkmeters must be warranted after consideration of the following:

(a) Generally, elderly tenants will not use excessive amounts of gas or electricity except possibly for space heating and air conditioning. Therefore, gas or electric checkmeters would not be appropriate in projects exclusively for elderly occupancy except where: (1) project supplied fuel or energy is used for space heating or air conditioning in individual dwelling unit equipment and (2) the tenant has control of the thermostat.

- (b) Where natural gas is supplied to individual units for cooking only, checkmeters would be inappropriate.
- (c) Some utility companies will not permit the installation of checkmeters or the collection of surcharges by a customer purchasing its services.
- (d) Electric, gas, and water checkmeters should be installed to measure all major utility consumption for non-dwelling purposes.

(1) Among the types of project installations which may be checkmetered are heating and cooling plants, elevators, offices, clinics, maintenance shops, community buildings, large ventilating fans, water pumping, sewage pumping plants and corridor and outdoor lighting.

(2) Examples of nonproject use which should be checkmetered are child-care centers, commercial establishments, and other housing projects supplied by project distribution systems.

- f. To preclude a utility or fuel dealer from declining to provide its service after a project is designed or under construction, a letter of obligation stating that its fuel or energy will be available to the project should be requested.
- g. Some utility companies and fuel suppliers may offer cash, special services or other promotions to entice developers to use their products and services. If a monetary value can be put on the promotion and if the tenants will benefit or if the initial cost of the project would be reduced as a result, the value of the promotion may be used in preparing a Life-Cycle Cost Analysis of Utility Combinations.
- h. The data in this handbook were developed on the basis of national averages; if reliable local data are available such data may be used in lieu of the handbook data.

1-5. COST COMPARISONS.

- a. A Life-Cycle Cost Analysis of Utility Combinations shall be prepared on Form HUD-51994 (Life-Cycle Cost Analysis of Utility Combinations), appendix 1.

(1) Form HUD-51994, Part A, provides columns for showing the details and costs of four utility combinations in summary form. Space is provided also for indicating the utility

combination recommended by the PHA/IHA and the appropriate justification for the recommended selection.

(2) Form HUD-51994, Part B, provides general information on local design conditions and the proposed project.

(3) Form HUD-51994, Part C, is used to develop monthly operating costs. In all combinations involving tenant-purchased fuels or energy, the amounts required by the project for elevators, streetlighting, water and sewage pumping, operating of maintenance shops, administration and community buildings, and for other general purposes should be included. Definitions and explanations of master-metered service and tenant-metered service used in the form and definitions of technical terms are in Chapter 2 of this Handbook.

(4) Form HUD-51994, Part D, is used to develop estimated initial costs and annual repair, maintenance, and replacement charges for the utility combinations.

b. Costs to be considered. In conducting the analysis, only facilities and equipment costs that are different in the various combinations need be considered. Lighting fixtures and cold water piping costs, for example, may be omitted as these will be installed under any combination. However, interior wiring and or gas piping costs will vary with the functions for which gas and electricity are used and must be included in the analysis of each combination.

1-6. PREPARATION OF LIFE-CYCLE COST ANALYSES OF UTILITY COMBINATIONS.

The Life-Cycle Cost Analyses of Utility Combinations shall be prepared in the following order using copies of Form HUD-51994.

a. Procedure.

(1) Obtain general project information and data and insert in Part B, Form HUD-51994. Include the number and type of dwelling units proposed and the utilities available at the proposed site. Information as to the number of dwelling units by number of bedrooms and the number and heights of dwelling buildings will increase the accuracy of the analysis. If the project is to be on scattered sites, use a separate sheet for each site showing only the data which are different for each site.

(2) From the utility systems and fuel suppliers, ascertain which utilities and fuels are available

for the project and obtain all current electric, gas, water and sewage

disposal rate schedules and costs, and oil and liquified petroleum gas prices which may be applicable for the project. Discuss rate applications with local utilities which will serve the project.

(3) Adjust energy and utility costs to reflect long-term energy price escalation. Obtain the escalation rates from the local utility and power commission, or use a escalation rate of no more than 7 percent if the rates are not available from the commission.

(4) Obtain the annual heating degree-days, the annual cooling hours, the design temperatures used, and the average annual cold water temperature.

(5) List on a separate sheet all feasible combinations of utilities, fuels, and purchase and utilization methods and select those that should be analyzed.

(6) Obtain the consumption requirements for the energy and fuel required for each combination to be analyzed from local experience in existing projects or from Chapter 2 and insert such data in Part C, Form HUD-51994.

(7) Consult with the public utility commission, local utility companies, Department of Energy, American Gas Association and the Edison Electric Institute on the long-term costs of energy for total life-cycle cost of utility systems. PHAs/IHAs shall use the following calculation showing the effects of the escalated energy rates in life-cycle cost estimates of utility combinations being analysed.

$$\text{(average current cost)} \times \frac{(1 + e)^n - 1}{e} \times \frac{1}{n}$$

Note: "e" is the energy escalation rate expressed as a decimal and "n" is the assumed economic life of a project. However, because of the uncertainty of long range estimates of energy costs "n" should not be greater than 20 years.

Example: Average current cost of electricity is \$25.00 per dwelling unit (DU) per month (Part C, line 14). The long-term escalation rate of electricity is 5 percent per annum. Determine the average monthly cost of electricity for a 20-year period.

$$\begin{array}{r}
 (\$25.00) \times (1 + .05)^{20} - 1 \times 1 \\
 \hline
 .05 \qquad \qquad \qquad 20
 \end{array}$$

12/85

Page 1-6

$$\begin{array}{r}
 =(25) \times (33.066) \times 1 \\
 \hline
 20 \\
 =\$41.33.
 \end{array}$$

\$41.33 is the adjusted average long-term cost of electricity and should be entered on line 16, Part A, Form HUD-51994. Similar calculations, using applicable energy escalation rates, should be made for gas and other fuels. Gas cost should be entered on line 17, Part A. Fuel cost should be entered on line 18, Part A.

(8) Calculate the monthly costs of fuels, energy, heating supplies, and heating labor. Heating labor costs should not be shown for individual dwelling unit equipment. Complete a Part C for each combination.

(9) Estimate the initial costs of the facilities and equipment required for each combination. Insert data in Part D, Form HUD-51994 and show source thereof.

(10) Compute the repair and maintenance, and replacement costs for each combination using Part D, Pages 1 and 2, Form HUD-51994. Total the costs and enter it on Page 2, Part D.

(11) Calculate the interest (line 16, Part A) using the HUD applicable interest rate based on the total initial costs per dwelling unit and enter the per dwelling unit per month (PUM) figure in the proper column of Part A. (The HUD interest rate can be obtained from the HUD Field Office.)

(12) Enter in Part A, Form HUD-51994, the appropriate data from Parts C and D and summarize the estimated costs PUM for the various combinations analyzed.

(13) Insert the number of the recommended combination and the justification of the recommendation at the bottom of Part A, Form HUD-51994.

b. Symbols to be used. Utility combinations should be listed on the analysis sheets, Form HUD-51994, using the following symbols:

(1) For Type of Domestic Hot Water and Space Conditioning

Equipment

IND - Individual Dwelling Unit Equipment
BLDG - One Plant in Each Building

Page 1-7

12/85

Equipment (continued)

GP - One Plant per Group of Buildings
CP - One Plant (Central Plant) for the Whole Project
or for One Site if there is More Than One Site
CPJ - One Plant for Two or More Projects
GWA - Gravity Warm Air Furnace with Ducts (No Blower)
FWA - Forced Warm Air Furnace with Ducts (Blowers)
FHW - Forced Hot Water System (With Pump)
LPS - Low-Pressure Steam System
HPS - High-Pressure Steam System
HTW - High-Temperature Water System
LPS-FHW - Low-Pressure Steam Converted to Forced Hot
Water at buildings
RT - Roof Top Forced Warm Air Ducted System
ACC - Central Plant Air Conditioning
ACR - Room Air Conditioners
ACM - Multi-Unit Air conditioning by Zones
BB - Baseboard
CBC - Cabinet Convectors
CC - Ceiling Cable
DH - Duct Heaters
AS - Active Solar Energy System
PS - Passive Solar Energy System
DUCS - Dwelling Unit Central System - Air Conditioning
FC - Floor Cable
HP - Heat Pump
MAH - Make-up Air Heaters
RWP - Radiant Wall Panels
RCP - Radiant Ceiling Panels
TWH - Through the Wall Heaters
TWHC - Through the Wall Heating and Cooling
HRS - Heat Recovery System
O - Other (Explain)

(2) For Fuel and Energy

E	-	Electricity	LPG- Liquified	PS- Purchased
G	-	Gas	Petroleum	Steam
FO	-	Fuel Oil	Gas	O- Others

(Specify)

(3) For Purchase Method: (See Chapter 2 for definition of "Master-Metered Service" and "Tenant-Metered Service.")

M- Master-Metered Service
T- Tenant-Metered Service

- c. Utility combinations for Study. The following is an illustrative example of a typical local utility combination:

Type of Installation	Combinations					
	No 1	No 2	No 3	No 4	No 5	No 6
Domestic Hot Water	Bldg	Ind	Ind	Bldg	Bldg	Bldg
Space Heating	Ind	Ind	Ind	Bldg	Bldg	Bldg
Space Heating System	BB	FWA	FHW	FHW	FHW	FHW
Space Cooling System	ACR	ACR	DUCS	ACC	ACC	ACR
Function	No 1	No 2	No 3	No 4	No 5	No 6
Lighting and Refrigeration	E-M	E-T	E-T	E-M	E-M	E-T
Cooking	E-M	E-T	G-T	G-M	G-M	G-T
Domestic Hot Water	E-M	E-T	G-T	G-M	FO-M	FO-M
Space Heating	E-M	E-T	G-T	G-M	FO-M	FO-M
Space Cooling	E-M	E-T	E-T	G-M	E-M	E-T

1-7. SELECTION OF UTILITY COMBINATION.

- a. The utility and fuel combination with the lowest cost PUM, including project and tenant costs, on Form HUD-51994 should be selected. If the cost difference between the lowest PUM and the next lowest is not significant, the comparative operating costs should be evaluated. The combination with the lower operating costs should be selected.
- b. A higher cost utility combination may be selected, with written Justification, if the following conditions exist:

(1) The lowest cost combination is unsuitable for the locality because State and/or local law prohibits the use of such combination. For example, coal may be cheaper but environmentally unacceptable;

Page 1-9
7418.1 CHG-1

5/95

(2) The inconvenience and expense of fuel handling are reduced or eliminated and the difference in monthly cost between the lowest cost combination to be selected is not more than five percent;
and

(3) The lowest cost combination is technically infeasible.

c. Tenant-metered service versus master-metered service.

If there is no substantial difference in cost per dwelling unit per month between utilities and fuels purchased by the tenants and those purchased by the PHA/IHA under a master-meter service rate, the PHA/IHA should select the utility combination that provides for tenant purchases. However, if experience indicates that a more satisfactory operation results where the PHA/IHA is responsible to the greatest extent feasible for the supply of utilities rather than tenants being responsible for the payment of bills to the utility company, the PHA/IHA may select master-metered service. In evaluating these two methods of providing utilities:

(1) Consideration should be given to the tenant's ability to pay the utility bills and to make a utility deposit;

(2) Availability of budget billing arrangements to tenants; and

(3) Whether the utility supplier permits checkmeters and surcharging for excess consumption.

d. Justification for the project utility and fuel combination shall be included in Part A, Form HUD-51994