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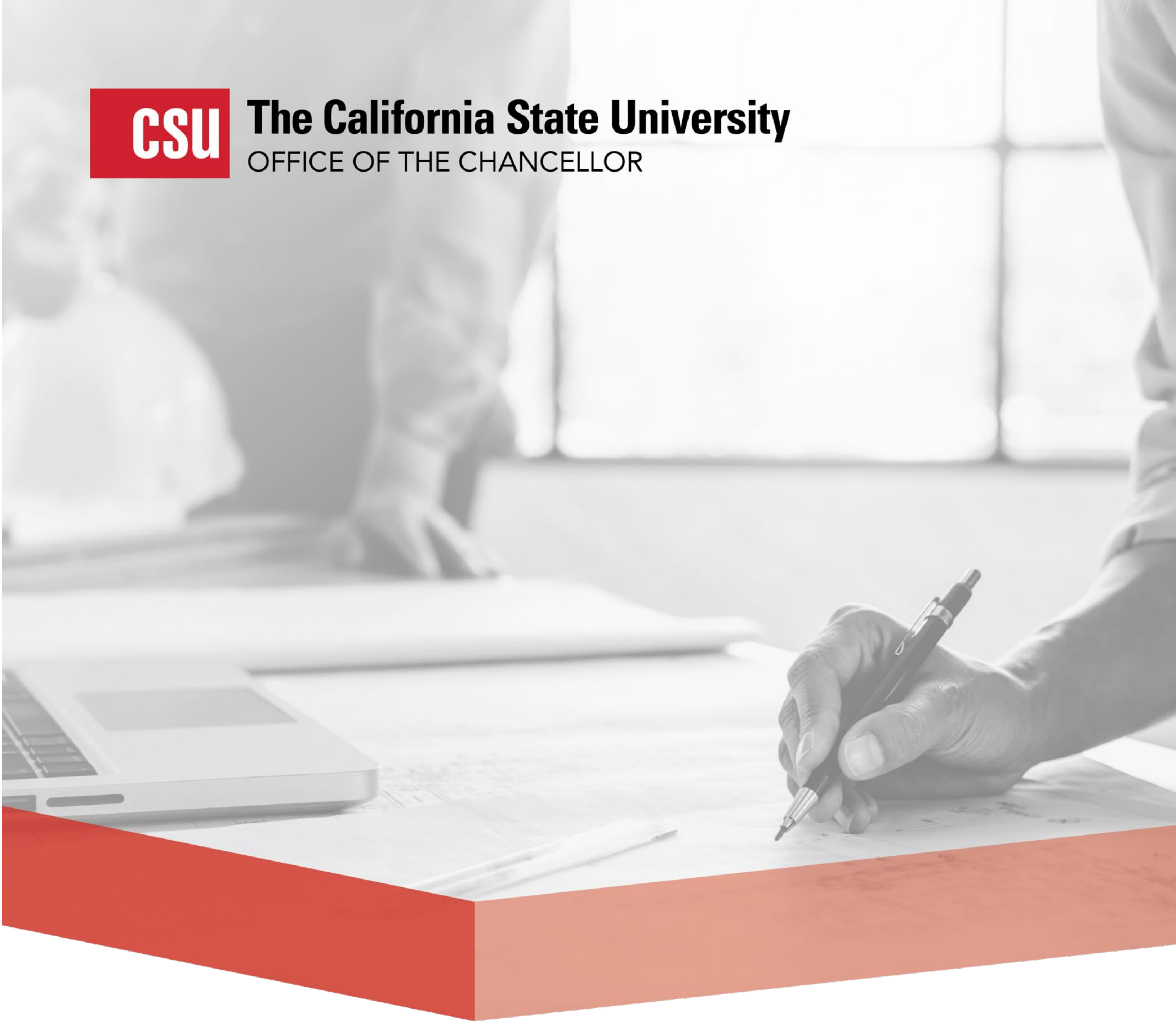

Utility Recharge Rate Computation Guidelines

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The California State University (CSU) gratefully acknowledges the effort and work of Jai Agaram, John Andary, Douglas Effenberger, Kent Peterson, Steven Strauss, and Steve Taylor.

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SECTION 1: Introduction

Purpose of the Document

This guideline describes basic principles and processes associated with calculation of utility recharge rates. It presents types of utilities generally found on campuses and explains the various cost components involved in establishing a cost-reflective recharge rate. This guideline illustrates both a rigorous methodology as well as a simplified approach to computing and updating the recharge rates and provides examples for each.

Other relevant California State University Guideline documents pertaining to this topic include:

Metering System Guidelines.

Utility Recharge Rate Computation Objectives

The ultimate objectives of a Utility Recharge Rate Calculation methodology are:

a. Develop a methodology for rate calculation that captures the major costs incurred by a campus in their procurement or manufacture of typical campus utility services. Using such a methodology, the utility rate charged to a campus 'customer' will be reflective both of the direct and indirect campus cost of providing the utility.

b. Outline methods to ensure consistency in the manner in which various utility customers within a campus are charged.

c. Ensure that the system can be reasonably maintained in-house by campus accounting and facilities staff and rates are updated on an ongoing basis to reflect changes in input cost that occur.

d. Allow individual campuses to make an informed decision between simplified or detailed recharge rate approaches.

e. Confirm that the selected campus recharge billing methodology is sufficiently flexible to handle the numerous types of infrastructure associated with production or distribution of a given campus utility system.

Recharge Approach

Each CSU campus has a mix of State funded and non-State funded buildings. Each campus central utility systems serve a mix of these State and non-State buildings. In order to be financially sustainable, all end-users who benefit from a campus central utility system must bear a representative share of the costs to provide these services. Allocation based on usage of a utility is the simplest method and has been adopted in this guideline. More advanced strategies such as time of use based pricing and demand based pricing are possible, but require significant campus commitment and a robust metering infrastructure that may not be in place. The simpler method can be extrapolated incrementally accommodate such strategies if necessary.

Application of this Guideline

Individual CSU campuses already have some form of a system of recharge already in place. As a delegated system, the CSU does not mandate a particular recharge scheme. Recognizing differing individual campus situations this guideline seeks to provide the framework for each campus to evaluate its existing recharge approach and make a business decision to revise as warranted.

Campuses should particularly guard against overly simplistic approaches, such as charge based on building area or area occupied by the end-user. Such approaches are likely not accurately reflecting actual costs to provide services, and may discourage auxiliaries from using utilities in the most efficient manner possible.

This guideline addresses such cost components as: a) Operations and Maintenance (O&M), b) capital cost, and c) transmission distribution losses, all of which reflect the full cost of providing utilities to the end use customer. It is therefore important for a campus to determine if it is appropriate to transition to a more rigorous method of establishing recharge rates as discussed in this guideline. Making such a transition may involve discussions both internally within the campus, as well as with auxiliary organizations. These discussions will ultimately determine the final form of the methodology described in this document.

This guideline is primarily intended to serve a technical resource to the campus. Policy related decisions as to what cost components are to be reasonably recharged to the end use customers is best left to the discretion of the campus management.

SECTION 2:
Categorization of Campus Utilities and Associated and Cost Components

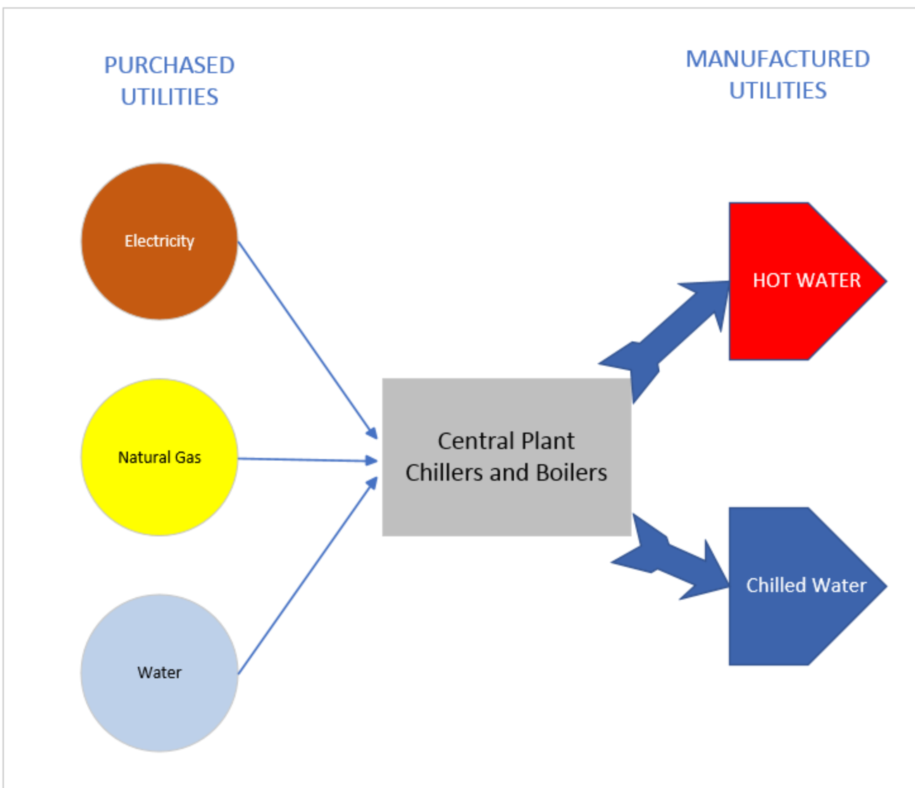
Utility Categories

Most utilities at any campus may be broadly categorized under two categories.

a. Purchased Utilities - such utilities as water, natural gas, electricity, sewer, and recycled water. These are generally purchased directly from the serving local utility under an established rate schedule. A campus may have multiple service accounts for each of the purchased utilities.

b. Manufactured Utilities - the electricity, heating, or cooling provided to a campus customer that is 'manufactured' by the campus using purchased utilities as an energy source. For example, Heating Hot Water (HHW) produced at a campus central heating plant is a manufactured utility which generally utilizes purchased natural gas and uses electricity to distribute the hot water to the various buildings.

Figure 2.1.1



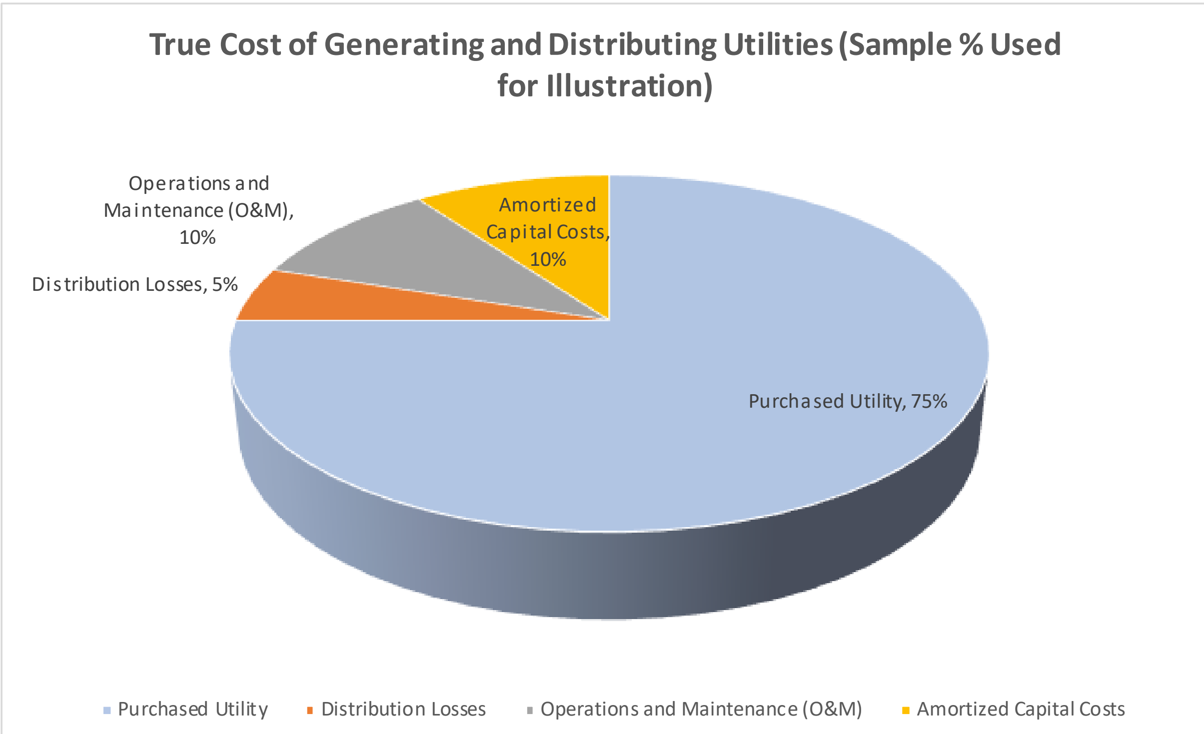
When a campus has a cogeneration plant, electricity can become both a purchased utility as well as a manufactured utility and the overall supply mix can consist of both.

It is important for the Recharge Rate calculation methodology to consider and account for all reasonable purchased utilities costs associated with its manufacturing.

Major Cost Components

There are basically four types of costs associated with any utility:

Figure 2.2.1



a. The Purchased Utility Cost is typically incurred on a monthly basis and an accounting system can easily track the quantity of purchases (e.g., therms of natural gas) and gross costs paid to the serving utility for the same, to derive the unit rate.

b. The Total Operations and Maintenance (O&M) costs include central plant labor, maintenance and repair costs, and chemicals, can be tracked as well on a monthly basis. However, because central plant staff can be involved with multiple utility systems, it is somewhat more complex to allocate O&M costs by utility. The campus plant manager is generally most suited to make a judgement call estimating portions of labor or maintenance costs that can be reasonably allocated to a specific utility.

c. The Capital/Debt Service Costs of major equipment are also a legitimate portion of the overall utility production cost. However, allocation of the same to a given utility requires some careful consideration of the following factors:

    i. Amount of the cost,

    ii. How the cost was financed (interest rate, debt term),

    iii. Life cycle of the associated equipment over which cost has to be amortized,

    iv. Split of the cost over different utilities.

Due to the long lived nature of utility infrastructure, costs from capital may need to be amortized over the expected life of the equipment.

d. The Utility Distribution Losses of a given utility is difficult to meter or establish precisely. This is discussed in more detail in Section 2.4.

Example Calculation of Recharge Rate for a Manufactured Utility

The following example in Table 2.3.1 is provided for central plant-produced Chilled Water (CHW). Cost components illustrated in this example include: Cost of purchased utilities, O&M Costs, and Capital Cost contributions for CHW production.

The example uses a campus with approximately 1 million GSF of space being cooled by CHW produced at a central plant using electric chillers. Metered CHW production on an annual basis is shown as approximately 2.4 million ton hours per year. The central plant in this example has a total of 3 operators who spend an average 50% of the time in maintaining the chillers and associated equipment at the central plant. The campus also spends a total of $30,000 per year in maintenance service contracts, chemicals and spare parts. To show the impact of capital cost on the recharge rate, the example shows a capital renewal cost of $1 million that was spent to upgrade the central plant. For amortization purposes, the example uses a 20-year cycle for the capital equipment, amortized at a bond interest rate of 3.5%.

The calculation shows the major cost components using the above example case. The purchased utilities portion alone represents a rate of 11.77 cents/ton hour. Including O&M costs increases the rate by 6.6 cents/ton hour. Capital renewal costs add 2.95 cents/ ton hour, bringing the overall rate to approximately 21.3 cents/ ton hour. The campus has determined that the average distribution losses for CHW between the central plant and campus buildings to be approximately 5%, so only 95% of the metered production can be effectively recharged. Since the intent would be to recover all the costs (including losses), the effective rate charged will therefore be higher by 5%.

Therefore, if the central plant is used to provide CHW to a potential campus customer such as a Student Union or a Housing Building on campus, the applicable recharge rate would be approximately 22.43 cents/ton hour.

This example illustrates four key points:

a. The true cost of doing business using a step-by-step approach to account for costs associated with a given utility

b. O&M and capital cost components are by no means trivial items that can lightly be ignored. In the above example, these amount to nearly 45% of the overall rate.

c. In this example, the campus average rate for two of the purchased utilities (electricity, water) was assumed as shown. In reality, these rates can also be established the same methodology to include associated O&M costs and capital costs.

   For example, if the campus had incurred major capital renewal costs for the electric sub-station upgrade that would be a legitimate cost that would impact the campus cost to produce. Thus the campus could decide to recoup these costs by including them in the average electricity price. More on this is presented in Section 3.0.

d. The example also demonstrates how to account and allocate of a utility distribution loss surcharge.

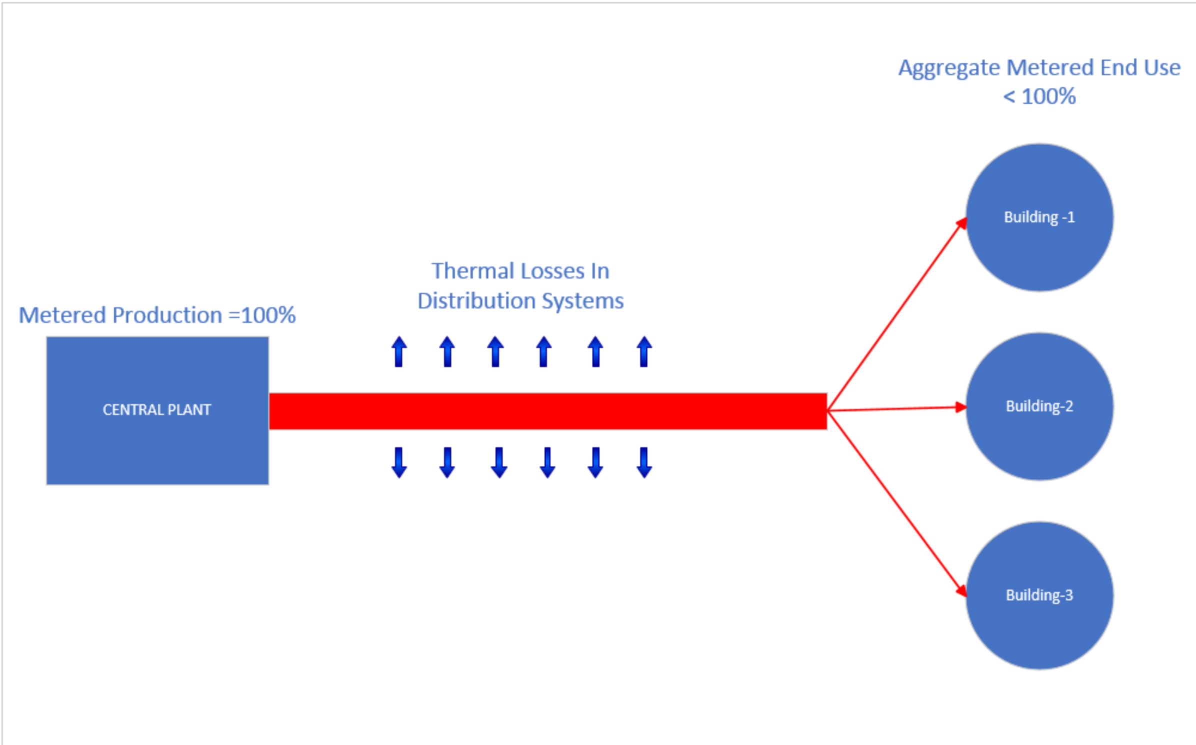
Table 2.3.1: Example Rate Calculation

Sample Chilled Water Recharge Rate Calculation		
Buildings served by central plant (GSF)	1,000,000	
Central plant peak load (Tons)	1,818	
Annual measured production (Ton Hours)	2,389,091	
A. Purchased Utilities for Production of Chilled Water		
A.1 Annual metered electricity purchase at central Plant (kWh)	2,030,727	
A.2 Campus-wide electricity purchase rate ($/kWh)	$ 0.13	
A.3 Annual electricity cost ($) [A.1 * A.2]	$ 263,995	
A.4 Annual water purchases at plant (x 1000 Gallons)	4,300.00	
A.5 Campuswide cost of water $/ 1000 Gallons	$ 4.00	
A.6 Annual cost of water ($) [A.4 * A.5]	$ 17,200	
A.7 Total Cost of Purchased Utilities used for Chilled Water Production ($) [A.3 + A.6]	$ 281,195	
B. Annual Operations and Maintenance Cost		
B.1 Total central plant labor cost/Year	$ 255,000	
B.2 % of labor allocated to chilled water production	50%	
B.3 Cost of Labor Allocated to Chilled Water Production ($) [B.1 * B.2]	$ 127,500	
B.4 Cost of Annual Service Contracts related to central plant	$ 30,000.00	
B.5 Total Operations and Maintenance cost allocated to chilled water production [B.3 + B.4]	$ 157,500	
C. Capital Cost allocation		
C.1 Capital Cost ($) associated with chiller renewal	$ 1,000,000.00	
C.2 Debt financed over (Years)	20	
C.3 Debt rate for financing (%)	3.50%	
C.4 Annual Debt Service Rate ($/Year)	$70,361	
D. Summay of Overall Costs Allocated to Chilled Water		
D.1. Purchased utilities cost ($) [A.7]	$ 281,195	$ 0.1177
D.2. O&M costs ($) [B.5]	$ 157,500	$ 0.0659
D.3. Capital renewal cost ($) [C.4]	$ 70,361	$ 0.0295
D.4 EFFECTIVE RECHARGE RATE ($/Ton Hour) [(D.1 + D.2 + D.3) / D.5] (Prior to consideration of distribution losses)	$ 0.2131	
D.5 Amount of chilled water produced (Ton Hour)	2,389,091	
D.6 Distribution Losses (%)	5%	
D.7 Metered End Uses that can actually be used for cost recovery (Ton Hours)	2,269,636	
D.8 RECHARGE RATE - ALLOWING FOR DISTRIBUTION LOSSES ($/Ton Hour)	$ 0.2243	

Calculating Distribution Losses

One of the key complexities in determining accurate recharge rates is associated with the estimation of distribution losses that are inherent in any utility system. It is straightforward to meter energy usage at the source as well as energy usage at every end use building, there is always a delta that cannot be measured. The delta between what is produced versus what is received at the end use points is the distribution loss.

Figure 2.4.1



Consider the following examples:

a. Distributing electricity across campus has losses that includes both resistive losses in the conductors that carry electricity, as well as transformation losses at building level service transformers. Depending on the loads and relative size of transformers, overall distribution losses may exceed 2-5% on an annual basis.

b. Hot Water heating systems have hot water (typically in the range of 140 -190 deg. F) running through long piping segments. Some of the piping may be in tunnels, some directly exposed to air, and others directly buried in ground. As the loop is typically maintained hot and running all year the overall thermal energy lost in the distribution system can be significant. With details on piping sizes, extent of insulation, and operating temperatures, such losses can be reasonably estimated, although the procedure can be quite tedious. Overall thermal energy lost in hot water distribution systems can potentially exceed 5-10% on an annual basis.

c. Steam distribution systems operate at a much greater temperatures (e.g., 350 deg. F for 125 PSIG steam) and they exhibit both thermal losses as well as material losses of steam escaping through the steam traps. Likewise, condensate return systems exhibit both leaks and thermal losses. Steam lines are generally not allowed to cool down and systems are maintained hot even during the summer months. For campuses operating such large scale steam distribution systems, thermal energy losses in steam systems can be in excess of 15-20%.

d. Chilled water systems exhibit lower losses because the lower temperature differential, typically in the range of 2-5% depending on the condition of piping and insulation.

If a campus intends to pass on such distribution losses to the end-use customers, the simplest approach would be to have a surcharge estimated once for each utility. The surcharge would apply to the overall recharge rate computed and inclusive of O&M cost component as well as capital cost component. It is possible to examine each specific distribution system at a given campus to make estimates of the distribution loss component. However, typical range of values are likely to be as below in Table 2.4.1.

Table 2.4.1

Type of Distribution System	**Distribution Loss Surcharge (%)**
Electrical system	3-5%
Heating Hot Water Distribution (Up to 190 deg. F)	5-10%
Domestic Hot Water System with constant recirculation	15%
High Temperature Hot Water Distribution System (> 220 deg. F)	7-12%
Steam Distribution System (125 PSIG.)	10-20%
Chilled water distribution system (40-45 deg. F)	2-5%
Natural Gas distribution system	Insignificant
Water Distribution System	Insignificant

SECTION 3:
Step-By-Step Procedure for Rate Calculation

STEP-1: Select Accounting Period

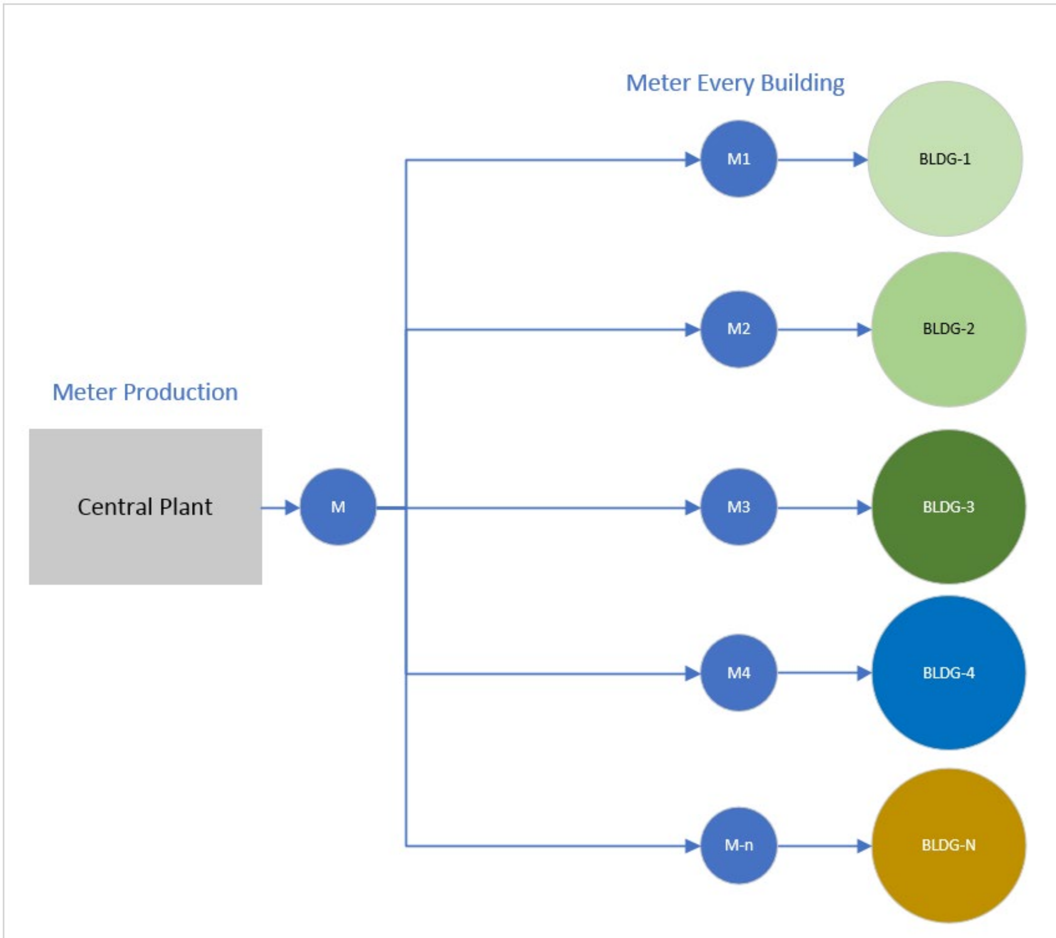
Cost and consumption values for utilities are generally tracked on a fiscal year basis. For CSU campuses, this is July 1 to June 30 of the following year. Calculating rates on a fiscal year average is recommended to provide customers a predictable utility rate and to minimize campus staff time devoted to calculating recharge rates.

The campus recharge rates will need to be reflective of the input costs corresponding to the same period along with whatever amortized long-term costs are being carried. An accounting system must be set up to track relevant metered data, O&M costs, utility purchase costs, amortized capital costs, etc. reconciled on a monthly basis.

STEP-2: Ensure Metering Systems are in Place and Working

Having access to reliable and accurate metered data for all utilities is a critical requirement to the recharge rate methodology described in this document. The following minimums are necessary to accurately track:

Figure 3.2.1



a. While external utilities to the campus are invariably metered, submetering of on-campus consumption for utilities remains incomplete. To track usage metering must be in place.

b. For campus central plants that produce and distribute chilled water, ensure meters record all production and distribution as well as energy inputs and water inputs to the manufacturing process. Also, ensure that there are chilled water meters at usage points where it is required to recharge the building or the customer. Depending on the type of chillers used, metered data at the central plant would include electricity, natural gas, potable water, and chilled water output.

c. Likewise, for central plants that produce and distribute hot water or steam, ensure meters record not only natural gas, but also electricity use and potable water use. Additionally, meter records on hot water or steam produced and distributed at all end points being recharged are needed.

d. Metered data required for the rate calculation should be compiled and available for the recharge rate calculation in a timely manner in order to ensure the ability to provide timely recharge bills. Therefore it is recommended that all major utility systems be metered and integrated into the campus Energy Information System.

STEP-3: Use Blended Rate Methodology

For any given utility, a campus may have multiple service accounts. This is very common for such purchased utilities as natural gas, electricity, and potable water. To keep accounting simple, it is best to establish a single comprehensive blended rate for each purchased utility based on total consumption on campus and total cost incurred for the same by the campus over a fiscal year. Example 3.3.1 below shows such a blended rate approach, using Purchased Electricity accounts for illustration purposes.

On a case by case basis, the campus can always exercise its discretion to allow a specific recharge customer to use building-specific/operation specific rate as opposed to a blended rate. For example, much in the same way that a public utility does, a campus for policy reasons may elect to apply a various tiers or surcharges over the true cost to provide to individual types of users.

Table 3.3.1 - Rate Calculation for Purchased Electricity

Sample Purchased Utility (Electricity) Recharge Rate Computation		
Fiscal Year	2017-18	
A. Purchases from Local Utility or Other Vendors	KWH Purchased	Bills Paid
A.1 Purchases at Service Account # 1 (kWh) (PV power, PPA - Deal @ 13 cents/kWh)	3,000,000	$ 390,000.00
A.2 Purchases at Service Account # 2 (kWh)	8,000,000	$ 960,000.00
A.3 Purchases at Service Account # 3 (kWh)	20,000,000	$ 1,700,000.00
A.4 TOTAL Purchases (kWh) [A.1 + A.2 + A.3]	31,000,000	$ 3,050,000.00
A.5 Blended Rate for Electricity Purchases ($/kWh) [Bills Paid / kWh Purchased]	$ 0.0984	
B. Annual Operations and Maintenance Cost		
B.1 Substation Maintenance, including any labor charges ($/Year)	$ 45,000	
B.2 Other Electrical Infrastructure Maintenace/Special Repairs ($)	$ 150,000	
B.3 Total Operations and Maintenance Cost Allocated to Electricity [B.1 + B.2]	$ 195,000.00	
C. Capital Cost allocation		
C.1 Capital Cost ($) of Sub-station Equipment Upgrade	$ 2,500,000.00	
C.2 Debt Financed over (Years)	20	
C.3 Debt Rate for financing (%)	3.50%	
C.4 Annual Debt Service Rate ($/Year)	$175,903	
(Applicable for 20-years, each year, starting from year installed)		
D. Summay of Overall Recharge Rates		
	Cost ($)	Rate ($/kWh) - with Surcharged added to energy cost
D.1. Purchased Utilities Cost ($) [A.4]	$ 3,050,000	$ 0.0984
D.2. O&M Costs ($) [B.3]	$ 195,000	$ 0.0063
D.3. Capital Renewal Cost ($) [C.4]	$ 175,903	$ 0.0057
D.4 EFFECTIVE RECHARGE RATE ($/kWh) [Sum of energy, O&M and Capital rates]		$ 0.1104
D.5 Distribution Loss Surcharge (%)		5%
D.6 RECHARGE RATE FOR ELECTRICITY, WITH DISTRIBUTION LOSS ACCOUNTED ($/kWh)		$ 0.1159

STEP-4: Establish Recharge Rates for Purchased Utilities First

As noted under section 2.1, there are two types of utilities: Purchased Utilities and Manufactured Utilities. Cost calculations for Manufactured Utilities such as Chilled Water (CHW) and Hot Water (HW) depend on the cost of Purchased Utilities such as Natural Gas (NG), Electricity (ELE) and Potable Water (PW). It is therefore important to establish the recharge rates for Purchased Utilities First.

The basic principle associated with establishing the rate for any purchased utility is the same as what is illustrated in Table 3.3.1.

Figure 3.4.1

- ☑ Cost of Purchased Utilities Considered
- ☑ Cost of Operations & Maintenance Considered
- ☑ Major Capital Expenditures Considered
- ☑ Distribution Loss/Surcharge Considered

a. Establish overall campuswide blended rate based on actual purchases and costs paid to the local utilities. For special cases such as cogeneration plants, see Section 3.8 of this guideline.

b. Determine annual O&M costs associated with the applicable utility.

c. Determine capital costs that are associated with the applicable utility.

d. Allocate O&M costs to the total purchases, making sure that both costs and consumption cover the same period.

e. Amortize capital costs over the life cycle of the infrastructure or debt term, whichever is lower and find the unit rate based on the consumption.

f. The overall recharge rate is therefore a summation of rates associated with the following as illustrated in example 3.3.1:

   i. Purchased component

   ii. O&M component

   iii. Capital component

g. Apply a distribution loss surcharge as described under section 2.4.

The example in Table 3.3.1 shows a campus with three service accounts, each on a certain rate schedule. It shows that the campus typically incurs a maintenance cost of $195,000/year in the maintenance of the sub-stations and infrastructure associated with distributing the electricity to the campus buildings. It also shows that the campus recently spent $2.5 million in sub-station upgrades. The example uses a campus with an average yearly electricity consumption of 31 million kWh. A blended rate approach is used where campus establishes a single campus-wide rate for the recharge of electricity. Incorporating a 5% distribution loss brings the revised rate to approximately 11.59 cents/kWh.

STEP-5: Compute Recharge Rates for Manufactured Utilities Next

After the rates for all purchased utilities are established, the rates for manufactured utilities such as steam, hot water and chilled water can be established using the same process.

In each case, the process would involve.

a. Identification of all purchased utilities that are needed to produce the manufactured utility
b. Consideration of any O&M costs that can be reasonably allocated to the utility
c. Consideration of any capital charges that maybe reasonably allocated to the utility
d. Accounting for distribution losses associated with the utility

Table 3.5.1 shows typical primary purchased utilities associated with each manufactured utility and the typical equipment or systems that utilize secondary utilities. For example, although natural gas is the primary energy source for producing hot water, production of the same also requires electricity for running the various pumps and fans. Since the extent of secondary utility usage can be significant, it is important to have metering systems in place to track the extent of energy or water used in production of any of the manufactured utilities.

Table 3.5.1

Typical Purchased Utility Requirement for Various Manufactured Utilities

Manufactured Utility	Primary Purchased Utility Used in Production	Secondary Purchased Utilities	Where Secondary Utility Used
Steam or Heating Hot Water	Natural gas / Propane		Feed water pumps
			Condensate pumps
			Boiler forced draft fans
			Building basic electrical needs
		Electricity	Control systems
		Water	Make up water
Chilled Water	Electricity		Cooling towers
	Natural Gas		Primary and secondary distribution pumps and condenser pumps
	Steam (e.g., third-party owned cogeneration plants)		Building basic electrical needs
		Electricity	Control systems

Special Considerations – Capital Cost Allocation Over Long Term

Operating and maintaining central utility systems is capital intensive. For example, chillers need to be changed out as they reach the end of useful life. Hot water piping or steam and condensate piping systems are subject to major repair costs over their life cycle. Electrical Sub-stations may need to be upgraded to accommodate increasing campus loads. Capital costs that reflect both initial and renovation costs are cost components that need to be accounted to reflect the true cost of campus utility provision. Since capital costs presumably need to be amortized over the term of the debt it is important to capture the “start” and “end” years during which they need to be allocated.

The Example in Table 3.6.1 shows several types of capital costs. Three different capital projects C.1, C.2 and C.3 are shown, each with an associated capital cost and the year in which costs are incurred. Each has an amortized amount that is applied for the duration corresponding to the amortization period as shown in Table 3.6.1.

As shown in the example, the allocation of capital costs in any year for heating hot water is based on all aggregate amortized cost associated with all applicable Capital Projects.

If the campus is producing and distributing 400,000 Therms/year of heating hot water in 2020, the capital cost portion of the recharge rate component for that year would be $386,986/400,000 or roughly 96 cents/Therm.

Table 3.6.1

Example of Heating Hot Water Infrastructure Costs

Project	Description	Investment	Start Year	End Year	Amount Amortized ($)
C.1	Major Direct Buried Line Repairs, Phase 1	$ 3,000,000.00	2012	2032	$211,083
C.2	Boiler Replacement	$ 1,500,000.00	2015	2035	$105,542
C.3	Heating Plant Transformer / Electrical Upgrade	$ 1,000,000.00	2018	2038	$70,361

Table 3.6.1 (Continued)

Aggregation of Year by Year Amortized Capital Costs

	C.1	C.2	C.3	Total Capital Charges Allocated in Year
2012	$0	$0	$0	$0
2013	$211,083	$0	$0	$211,083
2014	$211,083	$0	$0	$211,083
2015	$211,083	$0	$0	$211,083
2016	$211,083	$105,542	$0	$316,625
2017	$211,083	$105,542	$0	$316,625
2018	$211,083	$105,542	$0	$316,625
2019	$211,083	$105,542	$70,361	$386,986
2020	$211,083	$105,542	$70,361	$386,986
2021	$211,083	$105,542	$70,361	$386,986
2022	$211,083	$105,542	$70,361	$386,986
2023	$211,083	$105,542	$70,361	$386,986
2024	$211,083	$105,542	$70,361	$386,986
2025	$211,083	$105,542	$70,361	$386,986
2026	$211,083	$105,542	$70,361	$386,986
2027	$211,083	$105,542	$70,361	$386,986
2028	$211,083	$105,542	$70,361	$386,986
2029	$211,083	$105,542	$70,361	$386,986
2030	$211,083	$105,542	$70,361	$386,986
2031	$211,083	$105,542	$70,361	$386,986
2032	$211,083	$105,542	$70,361	$386,986
2033	$0	$105,542	$70,361	$175,903
2034	$0	$105,542	$70,361	$175,903
2035	$0	$105,542	$70,361	$175,903
2036	$0	$0	$70,361	$70,361
2037	$0	$0	$70,361	$70,361
2038	$0	$0	$70,361	$70,361
2039	$0	$0	$0	$0
2040	$0	$0	$0	$0
2041	$0	$0	$0	$0
2042	$0	$0	$0	$0

Special Considerations – O&M Cost Accounting

As demonstrated in the previous Table 2.3.1, O&M cost can be a significant component of the overall recharge rate. To accurately reflect this, it is important to set up accounting practices to help reasonably allocate ongoing O&M costs across each campuswide central utility. Very often, it is a judgement call on what portion of labor or maintenance costs are applicable to a given utility. The central plant manager by virtue of their close involvement in central plant operations is ideally suited to compile data and provide recommendations to campus management on how and where operator's time has been/ allocated and for which utility.

When allocating labor and maintenance costs, it is helpful to organize them by categories. Table 3.7.1 shows a suggested minimum level of detail.

Table 3.7.1

O&M Accounts for Tracking Annual Costs

	Labor	Service Contracts	Special Repairs	Chemicals	Spare Parts
Electrical					
Sub station	X	X	X		X
System-wide metering and instrumentation	X	X	X		X
Distribution side infrastructure, including Switches and Transformers	X	X	X		X
Building Specific electrical infrastructure	X	X	X		X
Natural gas					
Piping and Isolation valves	X	X	X		X
Meters and instrumentation	X	X	X		X
Building specific gas infrastructure	X	X	X		X
Hot Water or Steam					
Electrical gear specific to hot water/steam system	X	X	X		X
Central Plant Boilers, pumps and auxiliary equipment	X	X	X	X	X
Hot Water/Steam distribution system including piping, vaults and isolation valves	X	X	X	X	X
Systemwide metering and instrumentation	X	X	X		X
Building specific hot water/steam infrastructure	X	X	X		X
Chilled water					
Electrical gear specific to chiller plant	X	X	X		X
Central Plant chilers, pumps, towers and auxiliary equipment	X	X	X	X	X
Chilled waetr distribution system including piping, vaults and isolation valves	X	X	X	X	X
Systemwide metering and instrumentation	X	X	X		X
Building specific chilled water infrastructure	X	X	X		X
Water and Sewer					
Piping	X	X	X		X
Valves	X	X	X		X
Meters	X	X	X		X
Building specific water/sewer infrastructure	X	X	X		X

Special Considerations – Campus Cogeneration Plant-Generated Utilities

Campus cogeneration plants may include both a waste heat boiler and a waste heat/steam driven chiller. Such plants typically produce several utilities including electricity, steam or heating hot water and chilled water. The primary purchased utility for running a campus cogeneration unit is generally natural gas. More often than not, a campus cogeneration plant is just one virtual service account that, along with purchased utilities, provides the overall campus energy needs.

There are two approaches to determining effective purchased utility rate associated with such projects:

Approach 1: Value each utility based on business as usual (BAU) utility costs. For example, steam or hot water would be valued based on use of a fictitious boiler at a certain average efficiency (e.g., 80%). Electricity would be valued based on a fictitious purchased utility account calculated using the rate schedule that would have applied to the electricity if it had been purchased rather than produced by the cogeneration plant. Chilled water would be valued based on a fictitious all electric chiller plant operating at a certain assumed overall kW/Ton efficiency (e.g., 0.8 kW/Ton). Under this approach, the actual O&M costs of operating the Cogeneration Plant would not be used in establishing the rate. Also, capital and debt service costs associated with project development will not be used.

Approach 2: Value two of the utilities (typically, chilled water and hot water or just hot water if chilled water is not an output) based on BAU cost and calculate the remaining utilities (e.g., electricity) based recovering overall cost of operation including O&M costs and debt service, if any. For example, the remaining cost for electricity would be calculated as follows.

Overall cost of electricity production = [Cost of natural gas input + Cost of O&M + Cost of any additional standby or demand charges + Cost of debt service] – [Value of HHW or steam based on BAU pricing + Value of CHW based on BAU pricing]

Approach 1 is more suitable when a cogeneration project has been financed and the campus is still paying for the initial capital investment through the net utility savings. Approach 1 would establish higher recharge rates in comparison with Approach 2. This may be quite appropriate until all debt associated with the project is paid off.

Approach 2 is more suitable if all debt associated with the development of the project has been paid off and the overall campus is realizing net savings in utility costs (net of project O&M costs and net of extra demand and standby charges) through the operation of the Cogeneration Plant.

Table 3.8.1 illustrates sample calculations on how the recharge rates will be established using the above two approaches. For simplicity, other non-cogeneration related O&M costs and capital costs are not shown. However, those still need to be allocated per the principles outlined earlier.

Table 3.8.1

Sample Recharge Rate Calculation (Energy Component Only) With a Cogeneration Plant

Item	Description	Value	Comment
A.1	Annual Metered Natural Gas Use at Cogen plant (Therms)	2,521,895	<< Based on actual >>
A.2	Annual Net Electricity Production from Cogen plant (kWh)	23,652,000	<< Based on actual >>
A.3	Annual Hot Water / Steam Produced (Therms) using waste Heat	756,568	<< Based on actual >>
A.4	Power To Fuel Efficiency (For Info Only)	32%	<< Computed >>
A.5	% Overall Plant Thermal Efficiency (For info only)	62%	<< Computed >>
B.1	Cost of Cogeneration Plant O&M/Year	$ 425,736	<< Based on actual >>
C.1	Cost of Utility Purchased Natural Gas for Cogen Plant ($/Therm)	$ 0.40	<< Based on actual >>
C.2	BAU price for Utility Electric Purchases ($/kWh)	$ 0.12	<< Rate schedule analysis of applicable rate >>
C.3	BAU Price for boiler gas purchased for boilers ($/Therm)	$ 0.42	<< Rate schedule analysis of applicable rate >>
C.4	Avoided BAU Boiler Efficiency (%)	80%	<< Estimated>>
C.5	Cogeneration Plant O&M Cost/Year	$ 283,824	<< Based on actual >>
Approach -1 (Price Utilities Based on BAU Purchased Utility Prices)			
D.1	BAU Boiler Fuel Use (Therms)	945,710	[A.3 / C.4]
D.2	BAU Boiler Fuel Cost ($)	$ 397,198	[D.1 * C.3]
D.3	Recharge Rate for Steam/Hot Water ($/Therm) (Energy Component Only)	$ 0.5250	[D.2 / A.3]
D.4	Recharge Rate for Electricity ($/kWh) (Energ y Component Only)	$ 0.12	[C.2]
E.1	Cogeneration Project Revenues from Use of Thermal Output	$ 397,198	[A.3 * D.3]
E.2	Cogeneration Project Revenues from sale of electricity	$ 2,838,240	[A.2 * D.4]
F.1	GROSS REVENUES - Cogeneration Plant	$ 3,235,438	[E.1 + E.2]
F.2	Cost of Natural Gas Used for Cogen Plant ($)	$ 1,008,758	[A.1 * C. 1]
F.3	Cost of O&M of Cogen Plant ($)	$ 283,824	[C.5]
F.4	Added Standy/demand charges on Cogen Plant ($)	$ 709,560	<< Based on actual >>
F.4	NET REVENUES FROM COGEN. PLANT ($) (For Info only)	$ 1,233,297	[F.1 - (F.2 + F.3 + F.4)]
Approach -2 (Price Utilities Based on Actual Costs, AFTER Project Has no debt service needs)			
G.1	BAU Cost for Thermal Energy ($/Therm) (Energy Component only)	$ 0.53	<< Peg the smaller energy sale component at the BAU Rate >>
G.1	Revenues from Sale of Thermal Energy ($)	$ 397,198	[E.1]
G.2	O&M Costs for Cogen Plant ($)	$ 283,824	[F.3]
G.3	Added Standy/demand charges on Cogen Plant ($)	$ 709,560	[F.4]
G.4	Cost of Fuel for Cogen Plant ($)	$ 1,008,758	[F. 2]
G.5	Net Costs After Accounting for Thermal Energy Revenues ($)	$ 1,604,943	[G.2 + G.3 + G.4 - G.1]
G.6	Electricity Sales (kWh)	23,652,000	[A.2]
G.7	Recharge Rate for Electricity ($/kkWh) To Meet Costs	$ 0.0679	[G. 5 / G.6]

Once the effective energy rate out of a Cogeneration Plant is determined based on either Approach 1 or Approach 2 shown above, the balance of the process is the same as what was used for other utilities as illustrated in Steps 1 through 5. The Cogeneration Plant becomes just one of the virtual accounts as shown in example 3.3.1. and the overall campus rate computation process will continue as described under Steps 1 through 5.

Special Considerations – True Up Charges

From an accounting standpoint, there are two approaches that could be followed in operating a recharge rate system.

a. Approach 1: Calculate recharge rate on a monthly basis based on actual costs and invoices received from local utilities for all purchased utility accounts. Additionally actual O&M costs recorded on a monthly basis would be used for all ongoing monthly expenses.

b. Approach 2: Establish recharge rate at the beginning of the year based on a combination of latest Fiscal Year costs and best possible projection of anticipated costs for the next 12 months. A True-Up calculation is done during the last month of the fiscal year based on comparing actual costs versus what was estimated.

The first approach is more staff intensive as recharge rate calculation process has to occur once every month. The second approach simplifies the accounting process because the rate is established just once at the beginning of the year, with a True-Up adjustment made at the end of the year, potential unanticipated charges that the customer must be prepared for.

Figure 3.9.1

The true up charge is calculated as Actual incurred – Actual Recharged

A positive true up charge would mean that the cost estimate was too low, so recharge customers will need to pay a little more to help bear their proportionate share of the additional costs. True up charge may be reflected in the recharge billing during the last billing month or first month of the next fiscal year.

A negative true up charge would mean that the cost estimate was too high, and the extra revenues charged may be refunded back to the recharge customers in proportion to their payments during the fiscal year. Once again, the campus could decide to disburse the extra collection during either the last billing month or first billing month of the next fiscal year.

Special Considerations – Public-Private Partnerships

CSU will in some cases need to initiate the construction of infrastructure improvements needed to support general real estate development and finance with it with an internal program. These improvements may range from roads, interchanges, and other transportation improvements, to utility, water and sewer systems, to parks and other recreational facilities, and may also include site grading and demolition costs. CSU needs to be repaid for financing these improvements and the source of repayment to CSU will be charge backs to non-CSU users of the infrastructure.

The focus of this section is the recovery of costs by CSU from public-private partnership (P3) projects that will benefit from the construction of infrastructure improvements paid for by CSU earlier during the master plan phase. This will also apply to recovery of any other expenditures, such as the prior demolition of existing buildings, etc., by CSU on a site that will be used for a P3 or private development project.

The methodology to calculate the recovery of master plan infrastructure costs to CSU is to first remove from consideration the land area allocated for transportation (including roads), open spaces, pedestrian paths, utilities, and other services from the total land area of the master plan. The resulting subtotal is of usable/rentable land area that will be dedicated to CSU uses and to uses by others including P3 projects. To calculate the portion of infrastructure paid by CSU and by other users respectively, the total infrastructure cost should be divided by the subtotal of the land area that will be dedicated to CSU uses and to uses by others.

Example 1:

A $300 million infrastructure construction project for a master plan has a total site area of 173 acres, of which 73 acres in this example are allocated for roads, open spaces, pedestrian paths, utilities, and other services resulting in 100 acres usable/rentable for CSU uses and to uses by others. To determine the per acre infrastructure cost assigned to the CSU uses and to uses by others you would calculate as follows:

173 acres	Total site area
<u>73 acres</u>	<u>Roads, open spaces, etc.</u>
100 acres	**Subtotal usable/rentable by CSU and by others such as P3**
Calculation of per acre cost	
$300,000,000	Cost of infrastructure construction
<u>100 acres</u>	<u>Subtotal usable/rentable by CSU and by others such as P3</u>
$3,000,000	**Cost allocable per acre to CSU and other users**

If more than one year has passed between infrastructure construction and use by others then a future value calculation for the $3,000,000 is used to measure the nominal future sum of money that a given sum of money is worth at a specified time in the future assuming a certain interest rate.

This total sum may be paid for in a lump sum or over time. If the campus elects to be repaid over time the cost of capital must be considered and added as a cost to the P3. Continuing the example from above, if the P3 was for a one acre project:

$3,000,000	Total Cost of Site Work
30 years	Term of P3 Contract

4.5%	Interest Rate
$185,000	Annual Payment to CSU from P3

Example 2:

An existing reinforced concrete building with asbestos on a 12 acre site was demolished by CSU at a cost of $1,000,000, including asbestos remediation and regrading. The 12 acre site will now be used for a P3 project. In this case, CSU needs to recover from the P3 user either the $1,000,000 that was originally paid by CSU or if more than one year has passed, a future value calculation for the $1,000,000.

Campuses must also ensure that any major cost components as listed in Section 2 are recovered. This may result in a more robust and complete methodology than calculated for campus auxiliaries. Therefore, any connections with the campus utility infrastructure must be metered. Similarly, campuses must ensure that P3 contracts allow for the recovery of these cost components, especially regarding energy production contracts such as for a fuel cell or central plant.

SECTION 4:
Checklist to Confirm State of Readiness

Before the rigorous approach presented in these guidelines is launched, a campus is encouraged to review the following check list to determine its state of readiness. Depending on how these questions are addressed, it is conceivable that some modifications or simplifications are required based on unique campus requirements and constraints.

	Items to be checked
✓	Does the recharge policy on campus reflect establishing a recharge rate based on true cost of operation? True cost of operation will reflect all applicable cost components in the recharge rate computation.
✓	Is there agreement amongst all stakeholders that O&M costs and Capital Costs are legitimate cost components that should factor into the recharge rate calculation mechanism?
✓	Is there agreement amongst all stakeholders on adding a distribution loss surcharge to each of the central utilities? If so, have those been established for the campus based on the unique conditions and efficiency of existing distribution systems? (See Section 2.4)
✓	Is the accounting system set up to capture O&M costs and Capital Costs by each utility under clearly defined categories?
✓	Is the accounting system set up to track Capital Costs amortized over a period of time and calculate aggregated amortized amounts applicable to each utility for each future year?
✓	Are reliable and accurate metering systems in place for all purchased utilities?
✓	Does the campus have a cogeneration plant and is the campus using Approach 1 or Approach 2 for calculating the cogeneration plant related utilities? (See section 3.8)
✓	Are reliable and accurate metering systems in place to measure total chilled water output from the central plant?
✓	Are reliable and accurate metering systems in place to measure total hot water or steam output from the central plant?
✓	Are there reliable and accurate meters set up to account for Total State and Total Non-State consumption for each utility, preferably by building?
✓	Are simple templates, spreadsheets or databases set up to calculate the recharge rates based on the methodology provided, with customization as applicable to each campus setting?
✓	Has a sample calculation been performed for a typical month based on actual usage to compare the difference between recent recharge rates used and the more rigorous approach provided in this guideline?
✓	Has the format of recharge rate calculation (with back up information) been prepared and reviewed with end-users who will be recipients of the recharge bills in future?
✓	Have any concerns on the approach been discussed and resolved?
✓	Are there at least two staff representatives within Facilities who understand the overall process and can respond to any questions that maybe generated as the new methodology is implemented?

SECTION 5: Basic Principles Associated with Simplified Approaches

Recognizing that the ideal world of end use metering and rigorous accounting methodology may take some time to develop and implement, this section provides rate calculation methodology using simpler but approximate methods for establishing recharge rate for the most frequently encountered manufactured utilities. It is quite possible that a version of what is presented herein already exists in many of the campuses.

Energy Related Recharge Rate for Heating Hot Water (HHW or Steam)

R_{NG} - the unit price of natural gas in $/MMBtu during a given month

R_{ELE} - the unit price for electricity in $/kWh during a given month

B_{eff} - the average boiler efficiency of overall HHW or steam production,

E_{HHW} - the electricity requirement expressed as kWh/MMBtuh used in plant auxiliaries such as pumps, boiler auxiliary systems, heating plant building electricity, etc.

Recharge Rate for HHW in $/MMBtu

$$R_{HHW} = \frac{R_{NG}}{B_{eff}} + E_{HHW} * R_{ELE}$$

Example:

R_{NG} = $6/MMBtu

R_{ELE} = $0.12/kWh

B_{eff} = 75%

E_{HHW} = 4 kWh/MMBtuh

R_{HHW} = $8.48/MMBtuh of HHW

Based on the above, every MMBtuh of Heating Hot Water or steam measured at an end-user would be billed at the rate computed above.

Utility Related Recharge Rate for Chilled Water from an Electric Chiller

R_{ELE} - the unit price for electricity in $/kWh during a given month

R_{PW} - the unit price for potable water use in $/1000 Gallons

CH_{EFF} - the average chiller plant energy use in kWh/Ton Hour

PW_{EFF} - the average potable water use in the chiller plant (related to cooling tower water use for instance)

Note: Water cost contribution is generally a minor component of the overall costs.

Recharge Rate for CHW in $/Ton Hour

$$R_{CHW} = CH_{EEF} * R_{ELE} + PW_{EEF} * R_{P}$$

Example:

R_{ELE} = $0.12/kWh

R_{PW} = $4.00/1000 Gallons

CH_{EFF} = 0.95 kWh/Ton Hour (including all pumps, cooling towers, central cooling plant building auxiliary systems)

PW_{EFF} = 2 Gallons/Ton Hour

R_{CHW} = $0.1220/Ton Hour of CHW

Based on the above, every Ton Hour of chilled water usage measured at an end-user would be billed at the rate computed above.

Utility Related Recharge Rate for Chilled Water from a Gas Fired Absorption Chiller

R_{NG} - the unit price of natural gas in $/MMBtu during a given month

R_{ELE} - the unit price for electricity in $/kWh during a given month

CH_{EFF-G} -the average chiller plant natural gas use in MMBtu/Ton Hour

CH_{EFF-E} -the average chiller plant energy use in kWh/Ton Hour for all plant related electrical equipment including fans in the gas fired chiller, pumps, cooling towers, etc.

PW_{EFF} - the average potable water use in the chiller plant (related to cooling tower water use for instance)

Recharge Rate for CHW in $/Ton Hour

$$R_{CHW} = CH_{EEF-G} * R_{NG} + CH_{EEF-E} * R_{ELE} + PW_{EEF} * R_{PW}$$

Example:

R_{ELE} = $0.12/kWh

R_{NG} = $6/MMBtu

R_{PW} = $4.00/1000 Gallons

CH_{EFF-G} = 0.018 MMBtu/Ton Hour

CH_{EFF-E} = 0.25 kWh/Ton Hour

PW_{EFF} = 3 Gallons/Ton Hour

R_{CHW} = $0.1500/Ton Hour of CHW

Where source of heat for the absorption chiller is purchased steam instead of natural gas, the same process would apply. In this case, R_{NG} would be substituted with R_{STEAM} ($/MMBtu of steam). Likewise, CH_{EFF-G} would be substituted with $CH_{EFF-STEAM}$ (MMBtu of Steam/Ton Hour of chilled water).

O&M Cost Adders and Capital Cost Adders

Based on experience and historical costs incurred, it is possible to establish an approximate rate that is representative of the O&M costs and/or capital costs incurred in the production of each of the utilities.

For example, end use customers can be charged a flat rate (in $/kWh or $/MMBtu or $/Ton Hour) either as a percentage added on top of the utility rates computed previously as shown above.

It is recommended to determine these adders based on the guidelines provided in Section 3 and 4 of this document.

Surcharge on Distribution Losses

Even under the simplified approaches presented in this section, campuses may consider including a distribution loss surcharge as provided in Section 2 and Section 3 of this report. Section 2.4 of this document presents suggested range of factors for each of the utilities.