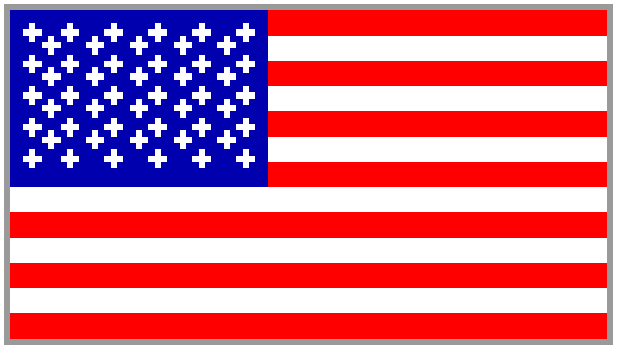
Rwanda Utilities Regulatory Agency (RURA), National Association of Regulatory Utility Commissioners (NARUC) and Missouri Public Service Commission (MPSC)

Regulatory Partnership Program



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RURA and NARUC Partnership

Wednesday, October 27th, 14:30 to 16:30

Warren Wood

Rate Design Exercise

(XYZ electric utility example)

Rate Design Exercise

For this rate design exercise we will use a relatively small electric utility with a relatively simple customer class breakdown and two generation resources.

Residential Customers: 10,000
Commercial Customers: 1,000
Industrial Customers: 10

The next four slides detail average annual usage characteristics and generation resource characteristics for determining rates in a rate case.

Rate Design Exercise

Customer Usage Patterns, Total Consumption and Peaks

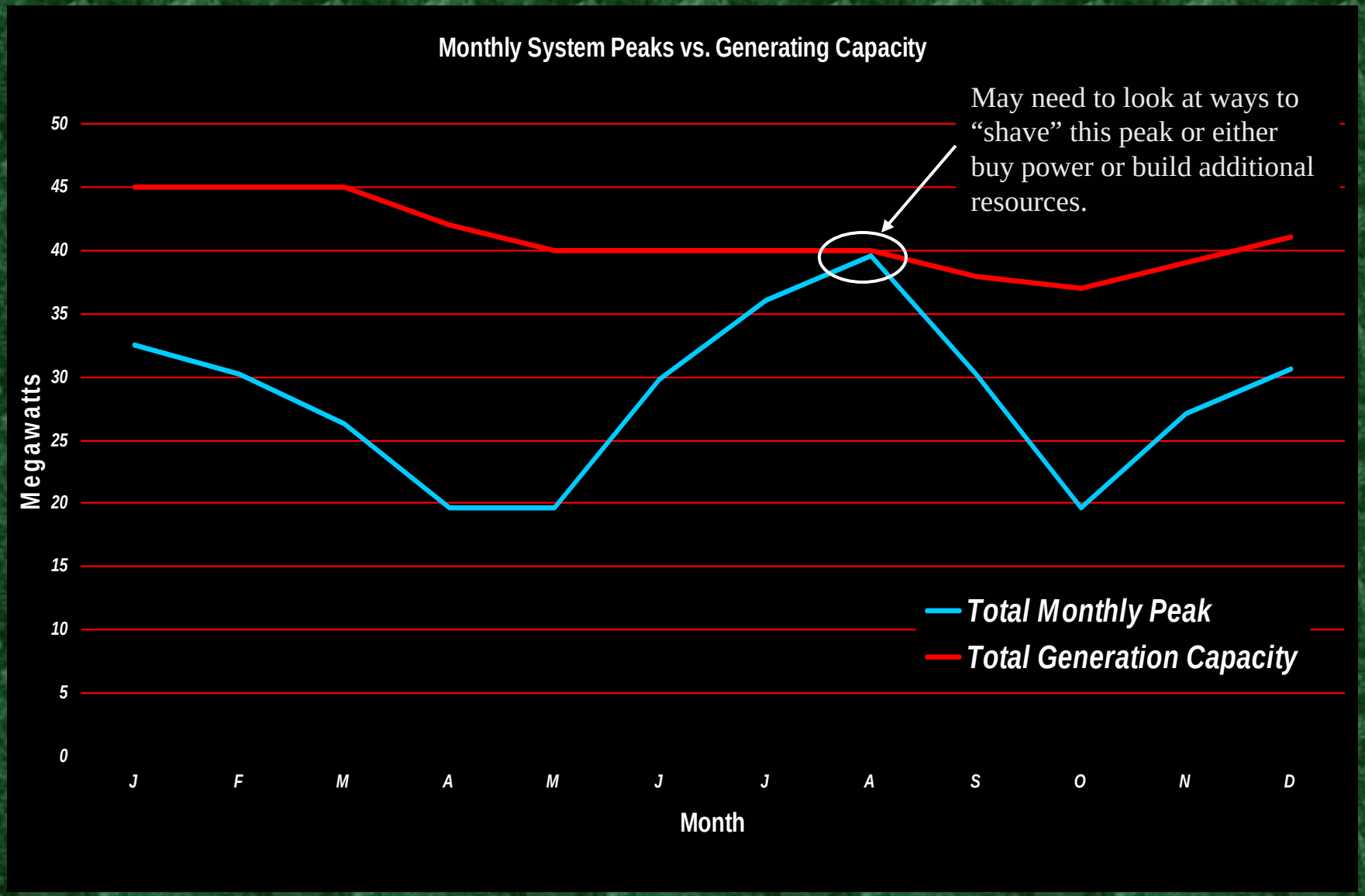
Residential Customers (10,000)												
Month	J	F	M	A	M	J	J	A	S	O	N	D
Avg. Monthly Usage (kWh)	950	894	782	559	559	894	1,061	1,173	894	559	782	894
Total Monthly Peak (MW)	26.02	24.49	21.43	15.31	15.31	24.49	29.08	32.14	24.49	15.31	21.43	24.49

Commercial Customers (1,000)												
Month	J	F	M	A	M	J	J	A	S	O	N	D
Avg. Monthly Usage (kWh)	2,922	2,532	2,143	1,948	1,948	2,338	3,117	3,312	2,532	1,948	2,532	2,727
Total Monthly Peak (MW)	6.40	5.55	4.70	4.27	4.27	5.12	6.83	7.26	5.55	4.27	5.55	5.98

Industrial Customers (10)												
Month	J	F	M	A	M	J	J	A	S	O	N	D
Avg. Monthly Usage (kWh)	9,023	8,271	8,271	7,519	7,519	8,271	9,023	9,023	8,271	7,519	8,271	9,023
Total Monthly Peak (MW)	0.16	0.15	0.15	0.13	0.13	0.15	0.16	0.16	0.15	0.13	0.15	0.16

Month	J	F	M	A	M	J	J	A	S	O	N	D
Total System Energy (MWh)	12510	11554	10047	7610	7610	11359	13822	15134	11554	7610	10436	11756
Total Monthly Peak (MW)	32.58	30.19	26.27	19.71	19.71	29.76	36.07	39.56	30.19	19.71	27.13	30.63

Rate Design Exercise



Rate Design Exercise

Hydroelectric Dam with 25 MW Capacity

Month	J	F	M	A	M	J	J	A	S	O	N	D
Hydroelectric Capacity (MW)	25	25	25	22	20	20	20	20	18	17	19	21

This is an older dam that has been in service more than 30 years of its original projected 40 year service life. It has relatively high annual maintenance costs but no fuel costs. It generates power on an almost continuous basis.

Rate Design Exercise

Natural Gas Combustion Turbine with 20 MW Capacity

Month	J	F	M	A	M	J	J	A	S	O	N	D
NG Turbine Capacity (MW)	20	20	20	20	20	20	20	20	20	20	20	20

This is a relatively new natural gas simple cycle combustion turbine. It has low annual maintenance costs but relatively high fuel costs. It generates power on an as needed basis.

Rate Design Exercise

The rate design effort should result in rates to each of the different customer classes that collect from these customers the cost they have imposed on the system to be served by the utility.

Rates should generally be designed to collect fixed costs through fixed charges.

Rates should be designed to collect variable costs through variable charges.

Rate Design Exercise

Functional Assignment is the first step in a class costs of service (CCOS) analysis and results in assignment of each of the utility's major functional costs into either Generation, Transmission, Distribution or Meters & Services costs areas. Depending on the complexity of the CCOS analysis, other functions may also be identified.

You start with the total revenue requirement and distribute these dollars to their respective functions.

Rate Design Exercise

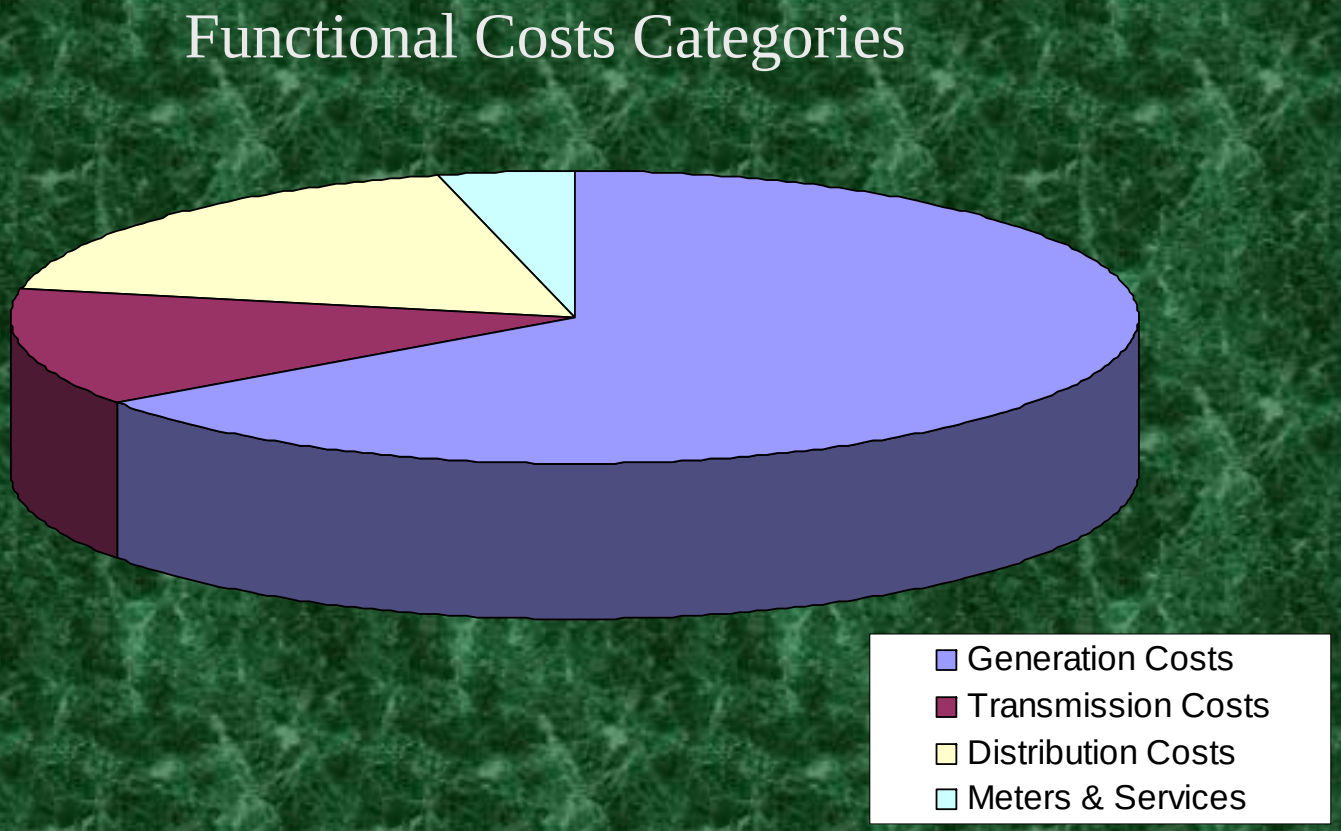
What revenue requirement did the rate case audit show?

$14,000,000

How were these dollars distributed when placed in their functional groups?

Generation Costs:	$9,100,000
Transmission Costs:	$1,820,000
Distribution Costs:	$2,520,000
Meters & Services:	$560,000

Rate Design Exercise



Rate Design Exercise

After functionalization of these dollars it is necessary to classify the costs in each functional area. Classification helps with assigning costs to different customer groups. The major classifications are demand, energy and customer related costs.

Demand related costs vary with the capacity requirements of each customer. Energy related costs vary with the consumption of energy by each customer. Customer related costs vary with the number of customers served and the types of services.

Rate Design Exercise

Generation costs can generally be broken into demand and energy costs.

Transmission costs are generally all demand related costs.

Distribution costs typically have demand and customer related costs.

Rate Design Exercise

Demand related costs typically include power production plant, most power plant maintenance and operation expenses, transmission, distribution plant and poles and transformers.

Energy related costs typically include fuel, fuel transportation, and other related expenses that vary with the energy produced/delivered like the variable portion of purchased power contract charges.

Customer related costs often include meters, services, meter reading expenses, and billing expenses.

Rate Design Exercise

How did the functionalized costs breakdown into their respective classifications?

Generation Demand Costs:	$3,640,000
Generation Energy Costs:	$5,460,000
Transmission Demand Costs:	$1,820,000
Distribution Demand Costs:	$1,512,000
Distribution Customer Costs:	$1,008,000
Meters & Services Customer Costs:	$560,000

Rate Design Exercise

After all costs have been functionalized and classified it is necessary to allocate them back to the classes of customers identified in the tariffs.

Demand related costs are typically allocated based on coincident and non-coincident peaks (different methods).

Energy related costs are typically allocated on total energy sold and can be varied by season.

Customer costs are often directly assigned.

Rate Design Exercise

Referring back to the customer peak information on the 4th slide, the following demand allocators can be calculated:

Demand Related Allocator:	Peak	Allocator
Residential	32.14	0.81246
Commercial	7.26	0.18348
Industrial	0.16	0.00406
	39.56	1

This allocator recognizes the coincident peak of all classes and distributes demand related costs to the classes accordingly.

Rate Design Exercise

Referring back to the customer energy information on the 4th slide the following energy allocators can be calculated:

Energy Related Allocator:	Energy	Allocator
Residential	100000	0.76336
Commercial	30000	0.22901
Industrial	1000	0.00763
	131000	1

This allocator recognizes the total energy use of all classes and distributes energy related costs to the classes accordingly.

Rate Design Exercise

Another allocator to calculate is for the meters and customer services. This can be approached through a weighted method as follows:

Customer Meter Allocator:	Cost/Meter	# Meters	Weight Factor	Allocator
Residential	$160	10,000	1600000	0.83835
Commercial	$300	1,000	300000	0.15719
Industrial	$850	10	8500	0.00445
			1908500	1

This allocator considers the costs of different meters and the number of customers in each customer class. This provides an allocator for customer meter purposes. These costs could have also just been directly applied.

Rate Design Exercise

Now that all costs have been functionalized, classified and allocators have been determined, the next step is actually designing the rates for each customer class.

Typical rate components include the following:

Customer Charge (flat charge per month)

Energy Charge (charge per kWh per month)

and possibly:

Demand Charge (charge per kW peak in year – charged monthly)

Fuel Adjustment Clause (charge per kW per month)

Rate Design Exercise

The customer charge usually recovers at least all customer costs from each customer class each month. It sometimes also includes some portion of demand related costs from each customer class each month.

The energy charge per kWh per month recovers at least all energy costs from each customer class each month based on their usage.

Rate Design Exercise

The class costs of service study allocates costs to customer classes but does not allocate these costs to different customers within the class based on their usage differences.

You have to look at how customers that use much more or much less than the average amount of energy in a month will be impacted. Placing more of the demand costs in the energy charge creates an incentive for customers to conserve and allocates more facilities costs to customers that use more energy.

Rate Design Exercise

The next three pages provide the rate design calculations for residential, commercial and industrial customers based on the numbers we looked at earlier.

In these examples, the customer charge only recovers customer costs.

The energy charge has been calculated based on all demand and energy costs.

Rate Design Exercise

Residential Customer Calculation	Dollars	Allocator	Allocated Costs
Generation Demand	$3,640,000	0.81246	$2,957,367
Transmission Demand	$1,820,000	0.81246	$1,478,684
Distribution Demand	$1,512,000	0.81246	$1,228,445
Distribution Customer	$1,008,000	0.83835	$845,062
Meters & Services Customer	$560,000	0.83835	$469,479
Generation Energy	$5,460,000	0.76336	$4,167,939
Demand Costs	$5,664,495		
Customer Costs	$1,314,540		
Energy Costs	$4,167,939		
10,000 Customers x 12 Months =	120,000	Bills	
Total Energy in Normalized Year =	100,000,000	kWh	
Customer Charge ($/Month) =	**$10.95**		
Energy Charge ($/kWh) =	**$0.0983**		

Rate Design Exercise

Commercial Customer Calculation	Dollars	Allocator	Allocated Costs
Generation Demand	$3,640,000	0.18348	$667,849
Transmission Demand	$1,820,000	0.18348	$333,925
Distribution Demand	$1,512,000	0.18348	$277,414
Distribution Customer	$1,008,000	0.15719	$158,449
Meters & Services Customer	$560,000	0.15719	$88,027
Generation Energy	$5,460,000	0.22901	$1,250,382
Demand Costs	$1,279,188		
Customer Costs	$246,476		
Energy Costs	$1,250,382		
1,000 Customers x 12 Months =	12,000	Bills	
Total Energy in Normalized Year =	30,000,000	kWh	
Customer Charge ($/Month) =	**$20.54**		
Energy Charge ($/kWh) =	**$0.0843**		

Rate Design Exercise

Industrial Customer Calculation	Dollars	Allocator	Allocated Costs
Generation Demand	$3,640,000	0.00406	$14,784
Transmission Demand	$1,820,000	0.00406	$7,392
Distribution Demand	$1,512,000	0.00406	$6,141
Distribution Customer	$1,008,000	0.00445	$4,489
Meters & Services Customer	$560,000	0.00445	$2,494
Generation Energy	$5,460,000	0.00763	$41,679
Demand Costs	$28,316		
Customer Costs	$6,983		
Energy Costs	$41,679		
10 Customers x 12 Months =	120	Bills	
Total Energy in Normalized Year =	1,000,000	kWh	
Customer Charge ($/Month) =	**$58.20**		
Energy Charge ($/kWh) =	**$0.0700**		

Rate Design Exercise

At this point it is important to go back and check if the billing determinants you have developed would collect the revenue requirement that you started with:

Charges	Units	Revenues
$10.95	120,000	$1,314,540
$0.0983	100,000,000	$9,832,434
$20.54	12,000	$246,476
$0.0843	30,000,000	$2,529,570
$58.20	120	$6,983
$0.0700	1,000,000	$69,996
	Total -->	$14,000,000

Rate Design Exercise

This was a very simple example of a utility class costs of service study and rate design. Additional allocators could have been applied to demand and energy to recognize seasonal variations in these costs.

In this example the peak for all classes occurred at the same time. This is not usually the case, other demand allocation methods can be used to account for non-coincident peaks of different customer classes.

Rate Design Exercise

In this example none of the customer classes were charged a demand charge based on their peak usage.

All of these costs were embedded in the energy charge on a per kWh basis. Larger customers are often charged a demand charge for their peak usage and then charged a lower per unit energy charge. This moves more demand costs over to customers that place a larger peak on the system and makes energy usage on a continuous basis more attractive.

Rate Design Exercise

The spreadsheet below incorporates the class peak demand and calculates a demand charge to collect these costs from the industrial customers:

Industrial Customer Calculation	Dollars	Allocator	Allocated Costs
Generation Demand	$3,640,000	0.00406	$14,784
Transmission Demand	$1,820,000	0.00406	$7,392
Distribution Demand	$1,512,000	0.00406	$6,141
Distribution Customer	$1,008,000	0.00445	$4,489
Meters & Services Customer	$560,000	0.00445	$2,494
Generation Energy	$5,460,000	0.00763	$41,679
Demand Costs	$28,316		
Customer Costs	$6,983		
Energy Costs	$41,679		
10 Customers x 12 Months =	120	Bills	
Total Energy in Normalized Year =	1,000,000	kWh	
Total Class Peak Demand =	161	kW	
Customer Charge ($/Month) =	**$58.20**		
Energy Charge ($/kWh) =	**$0.0417**		
Demand Charge ($/kW/Month) =	**$14.69**		

Rate Design Exercise

The Internet has numerous class costs of service analysis examples and studies for further research on the topic. NARUC has several good presentations on the topic as well. Considering visiting the following links:

http://www.norwaymi.com/city_services/COS-STUDY.pdf

http://www.ravallielectric.com/ratedsgn.htm

http://www.gvea.com/memserv/makingrates.php?printable=yes

Questions?

"Hands On" Rate Design Exercise

In this example you will fill in some of the numbers as we go along. The customer and revenue information we will work from:

Revenue Information

Revenue Needed	**$5,286,232**
Customer Related Revenue	**$313,662**
Energy Related Revenue	**$2,697,570**
Peak Related Revenue	**$2,275,000**

Customer Information

Classes	Customers (Not Bills)	Monthly Sales per Customer (kWh)	Annual Sales (kWh)	Peak Load (MW)
Residential	2,855	1,000	34,260,000	10.6
Small General Service	367	2,250	9,909,000	3.2
Large General Service	25	72,500	21,750,000	5.4
Large Volume Service	2	1,000,000	24,000,000	3.4
	3,249	1,075,750	89,919,000	22.6

"Hands On" Rate Design Exercise

Now we need to clearly identify peak, energy and customer related inputs for determining allocators:

Allocation Inputs

Classes	Customer Related Inputs ($/Cust./Month)	Energy Related Inputs (kWh)	Peak Related Inputs (MW)
Residential	$7.25	34,260,000	10.60
Small General Service	$9.25	9,909,000	3.20
Large General Service	$65.00	21,750,000	5.40
Large Volume Service	$210.00	24,000,000	3.40
		89,919,000	22.60

Customer Inputs

Customer Related Inputs ($/Cust./Month)	Customers (Not Bills)	Monthly Customer Expense
$7.25	2,855	$20,698.75
$9.25	367	$3,394.75
$65.00	25	$1,625.00
$210.00	2	$420.00
		$26,138.50

“Hands On” Rate Design Exercise

Now calculate the peak, energy and customer allocators:

Allocation Factors

Classes	Cust. Related Allocation Factor	Energy Related Allocation Factor	Peak Related Allocation Factor
Residential Small General Service Large General Service Large Volume Service			

These allocators will come from the customer inputs on the previous slide

These allocators will come from the energy inputs on the previous slide

These allocators will come from the peak inputs on the previous slide

“Hands On” Rate Design Exercise

With the numbers filled in:

Allocation Factors			
Classes	Cust. Related Allocation Factor	Energy Related Allocation Factor	Peak Related Allocation Factor
Residential	0.7919	0.3810	0.4690
Small General Service	0.1299	0.1102	0.1416
Large General Service	0.0622	0.2419	0.2389
Large Volume Service	0.0161	0.2669	0.1504
	1.0000	1.0000	1.0000

“Hands On” Rate Design Exercise

Now calculate the class revenues from the allocators on the previous slide and the peak, energy and customer related revenues on the first slide in this example:

Class Revenues			
Classes	**Customer Revenues**	**Energy Revenues**	**Peak Revenues**
Residential **Small General Service** **Large General Service** **Large Volume Service**			

"Hands On" Rate Design Exercise

With the numbers filled in:

Class Revenues

Classes	Customer Revenues	Energy Revenues	Peak Revenues	Total Revenues
Residential	$248,385	$1,027,800	$1,067,035	$2,343,220
Small General Service	$40,737	$297,270	$322,124	$660,131
Large General Service	$19,500	$652,500	$543,584	$1,215,584
Large Volume Service	$5,040	$720,000	$342,257	$1,067,297
	$313,662	$2,697,570	$2,275,000	$5,286,232

Check that total revenues equal the revenue needed that we started with.

"Hands On" Rate Design Exercise

Now we need to describe the units under which the needed revenues will be collected from each of the customer classes:

Units to Collect Revenues

Classes	Customer (Annual Bills)	Energy (Sales)	Peak (Sales*)
Residential	34,260	34,260,000	34,260,000
Small General Service	4,404	9,909,000	9,909,000
Large General Service	300	21,750,000	21,750,000
Large Volume Service	24	24,000,000	24,000,000

*** While Customer charge revenues and Energy revenues have corrsponding monthly units, monthly peaks are not available in this case.**

“Hands On” Rate Design Exercise

Now divide the class revenues by the units to collect revenues (the last two pages) to determine the class rates:

Class Rates

Classes	Customer Rates	Energy Rates	Peak Rates	Total Energy Rates
Residential Small General Service Large General Service Large Volume Service				

“Hands On” Rate Design Exercise

With the numbers filled in:

Class Rates

Classes	Customer Rates	Energy Rates	Peak Rates	Total Energy Rates
Residential	$7.25	$0.0300	$0.0311	$0.0611
Small General Service	$9.25	$0.0300	$0.0325	$0.0625
Large General Service	$65.00	$0.0300	$0.0250	$0.0550
Large Volume Service	$210.00	$0.0300	$0.0143	$0.0443

In this example the LGS and LVS customers did not have a demand charge calculated for them although this could have been done.

Questions?