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LRMC MODEL DOCUMENTATION AND USER GUIDE

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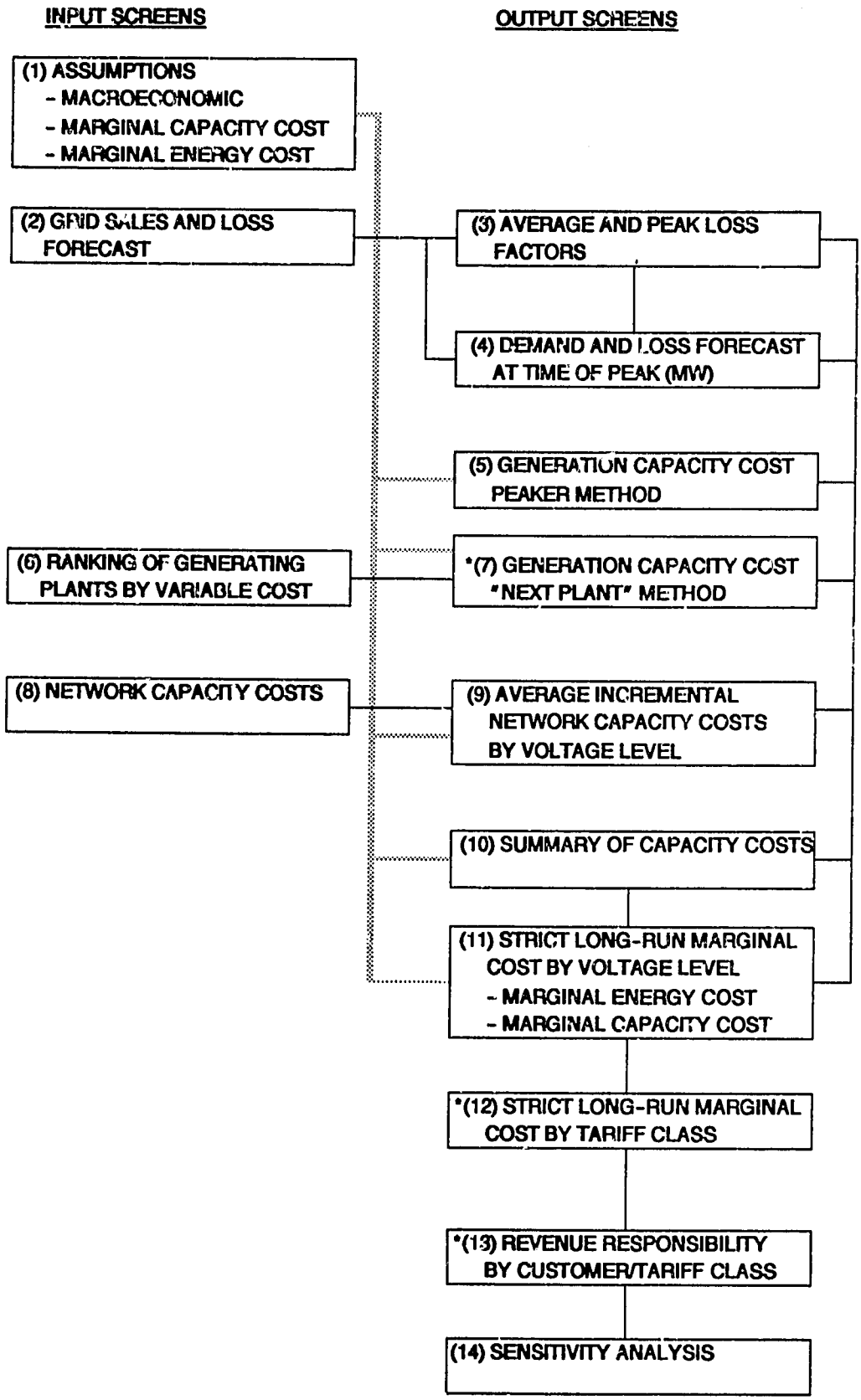
   A review of the major steps required to prepare a complete new run of the model with revised data inputs.

MODEL FOR CALCULATING SYSTEM
LONG RUN MARGINAL COSTS AND AVOIDED COSTS



NOTES ON THE CONTENTS OF EACH SCREEN

(1) Macroeconomic assumptions are used to convert financial to economic and market to border prices throughout model.

Marginal Capacity Cost assumptions provide data to Screens 5 and 7.
Marginal Energy assumptions provide data to Screen 10.
User notes are added to clarify current model run.

(2) User provides peak demand (MW), gross generation (MWh), sales forecast by voltage level (MWh), and allocation of total losses at each voltage level for use in Screens 3 and 4.

(3) Expresses losses as a percent of incoming load, on average and at time of system peak.

(4) Derives MW requirements of losses and consumption at each voltage level, and calculates the incoming peak at each level.

(5) Calculates the generation capacity cost per kW of the peaking unit defined in Screen 1.

(6) Generating plant variable costs for use in Screen 7.

* (7) Calculate the generation capacity cost per kW of the "Next Plant" defined in Screen 1, and the fuel cost savings resulting from this plant displacing other peaking capacity.

(8) User enters the investment plan for network capacity expansion at each voltage level, excluding rehabilitation or other maintenance; foreign and local cost streams are separated.

(9) Long-run average incremental costs of network capacity by voltage level are calculated from the data in Screens 4 and 8.

(10) Capacity costs calculated in Screens 5, 7, and 9 are summarized and adjusted to local prices and for reserve margin and station losses based on assumptions from Screen 1.

(11) Strict LRMC by voltage is shown by component:
Cumulative marginal capacity costs per coincident kW are derived from Screen 10.

Marginal Energy Costs are calculated from the assumptions provided in Screen 1.

* (12) The results in Screen 11 are restated by tariff class and service voltage, adjusting for coincidence, load factor, and peak energy shares entered by the user. Recent tariff yields and sales data are entered here for use in Screens 13 through 15.

* (13) Strict LRMC by customer class from Screen 12 is adjusted for revenue neutrality based on financial revenue requirements, and, with this information, ultimate class responsibility (adjustments for "second-best" considerations) is assigned by the user.

(14) Sensitivity of strict LRMC results to changes in key input parameters.

Notes: An asterisk (*) indicates that some inputs also required in these screens. Screens 12 and 13 each appear three times in the model to permit analysis of the EEA (Bulk) EDA (Retail), and Unified Power systems.

STRICT LONG-RUN MARGINAL COST MODEL
COMMAND STRUCTURE

The model command structure consists of a main menu and four sub-menus. All headings direct the user to a sub-menu or a specific screen of input or output data within the program. The keys {ALT} and {A} returns control to the main menu. Users can freely move through the model by using the menus, or stepwise by pressing {END} and {DOWN} while in Column A. Results must be saved using standard LOTUS 123 procedures; if you do not save data inputs, they will be lost.

The command menus and their data elements are described below:

Main Menu

DATA	RUN	PRINT	HELP	QUIT

DATA	Select Data Tables to View or Edit
RUN	Recalculate Results using Current Data Values
PRINT	Print All Tables
HELP	Introduction to the Program
QUIT	Exit Macro. Don't forget to save results using standard Lotus 123 procedures

Data Menu

ASSUMP-TIONS	LOSSES	FORECAST	CAPACITY COSTS	ENERGY COSTS	LRMC	QUIT

ASSUMPTIONS	Basic Economic and Engineering Assumptions (to Screens 1 and 2)
LOSSES	Average and Peak Loss Factors (to Screen 3)
FORECAST	Demand and Loss Forecast at Time of System Peak (to Screen 4)
CAPACITY COSTS	Network & Generation Capacity Costs (to Menu)
ENERGY COSTS	Marginal Energy Costs by Season and Voltage Level (to Screen 11)
LRMC	Strict LRMC, Revenue Responsibility, Tariff Design, and Bill Impact (to Menu)
QUIT	Return to Main Menu

Capacity Cost Menu

PEAKER	"NEXT PLANT"	GENERATING PLANTS	NETWORK	SUMMARY	QUIT

PEAKER METHOD	Generation Capacity Costs using Peaker Method (to Screen 5)
"NEXT PLANT"	Generation Capacity Costs using "Next Plant" Method (to Screen 7)
GENERATING PLANTS	Ranking of Plants by Variable Cost for "Next Plant" Method (to Screen 6)
NETWORK	Long-Run Average Incremental Cost Analysis of Network Capacity (to Menu)
SUMMARY	Summary of All Capacity Costs (to Screen 10)
QUIT	Return to Main Menu

Network Capacity Cost Menu

INVEST-MENTS	LRAIC	QUIT

INVESTMENTS	Transmission & Distribution Capacity Cost Investment Data (to Screen 8)
LRAIC	Long-Run Average Incremental Costs by Voltage Level (to Screen 9)
QUIT	Return to Main Menu

LRMC Menu

VOLTAGE	CLASS	REVENUE RESPONSIBILITY	SENSITIVITY	QUIT

VOLTAGE	Strict LRMC by Voltage Level (to Screen 11)
CLASS	Strict LRMC by Tariff Class (to Screen 12)
REVENUE RESPONSIB	Revenue Responsibility by Customer/Tariff Class (to Screen 13)
SENSITIVITY	Sensitivity to Changes in Key Input Assumptions
QUIT	Return to Main Menu

The command structure shown here is implemented through a set of Lotus 123 macro statements which appear at the end of the model with the range name \0. This is an automatically executed macro that is invoked whenever the program is loaded.

MODEL FOR CALCULATING SYSTEM LONG RUN MARGINAL COSTS

SCREEN 1

EEA/UNIFIED POWER SYSTEM
BASIC PLANNING ASSUMPTIONS

Macroeconomic Assumptions:

Fiscal Year of Study	1991
Last Planning Year	2000
Planning Reserve Margin	20.0%
Discount Rate 1/	10.0%
Conversion Factors:	
Foreign 2/	1.00
Standard (SCF) 3/	0.95
Local Labor 4/	1.00
Exchange Rate (LE/US$) 5/	3.30

Assumptions for Marginal Capacity Cost Calculations:	GENERATION PEAKER METHOD	GENERATION "NEXT PLANT"	TRANSMISSION & DISTRIBUTION 6/ VHV	HV	MV	LV
Marginal Plant	NEW-CT	COAL				
Life (years)	25	30	40	40	25	25
O&M and A&G (% of capital cost)	0.64%	0.88%	2.0%	2.0%	2.5%	2.5%
T&D Construction Lag (years)	-	-	1	1	1	1
Year Generation Required	1993	1993				
Capital Cost or Distribution: 7/						
Foreign (LE/KW or %)	654.9	1826.5				
Local Materials	327.5	913.3				
Local Labor (d)	0.0	0.0				

Assumptions for Marginal Energy Cost Calculations:	PEAK	OFF-PEAK
Marginal Plant	NEW-CT	NEW-GS
Heat Rate (BTU/kWh)	14000	9800
Fuel Used	GAS/SOL	GAS/MAZ
Fuel Cost (US$/unit)	1.97	1.97
Heat Content (MMBtu/unit)	1.00	1.00
Variable O&M ($/MMBtu)	0.002	0.020

FUEL COSTS	$/MMBtu	$/Tonne	LE/Tonne
Coal	1.80	48.60	160.38
Gas/Mazout	1.97	81.74	269.75
Solar	4.36	189.49	625.30

1/ Estimates of the opportunity cost of capital range from 6 to 10 percent.
2/ Taxes/duties excluded from cost streams; no adjustment.
3/ Based on discussion with USAID economists.
4/ Unskilled labor was not separated in the cost streams.
5/ Unless otherwise noted, all currency expressed in LE.
6/ Network defined as: VHV (above 66 kV), HV (66/33 kV), MV (20/11/6.6 kV), LV (below 6.6 kV).
7/ Distributions are not used; actual estimates are available.

SCREEN 2

EEA/UNIFIED POWER SYSTEM
GRID SALES AND LOSS FORECAST

YEAR ENDING	PEAK (MW)	GROSS GEN (GWH)	LOAD FACTOR	TOTAL SALES (GWH)	SALES BY VOLTAGE LEVEL (GWH) GEN	VHV	HV	MV	LV	AVERAGE LOSSES BY VOLTAGE LEVEL (GWh) STN USE	Allocation of network losses (%) 1.5% VHV	4.0% HV	4.4% MV	4.5% LV
1991	7152	44297	70.7	36368	0	6770	2448	8783	18367	1816	637	1698	1868	1910
1992	7644	47201	70.5	38752	0	6980	2615	9421	19736	1982	674	1786	1976	2021
1993	8123	49947	70.2	41056	0	7054	2793	10105	21104	2098	708	1887	2075	2123
1994	8640	52923	69.9	43556	0	7144	2983	10839	22590	2276	739	1970	2167	2216
1995	9189	56154	69.8	46214	0	7294	3187	11627	24107	2415	784	2090	2299	2351
1996	9736	59308	69.5	48869	0	7344	3404	12472	25649	2550	822	2191	2410	2465
1997	10461	63639	69.4	52502	0	7711	3637	13379	27775	2800	868	2316	2547	2605
1998	11108	67562	69.4	55806	0	8097	3886	14352	29472	2973	915	2440	2684	2745
1999	11778	71646	69.4	59251	0	8502	4152	15395	31202	3152	963	2567	2824	2888
2000	12472	75896	69.5	62842	0	8927	4437	16515	32964	3415	1004	2677	2945	3012

SCREEN 3

EEA/UNIFIED POWER SYSTEM
AVERAGE AND PEAK LOSS FACTORS (FRACTION OF INCOMING)

YEAR ENDING	STATION USE AVG	STATION USE PEAK	VHV AVG	VHV PEAK	HV AVG	HV PEAK	MV AVG	MV PEAK	LV AVG	LV PEAK
1991	0.041	0.041	0.015	0.019	0.048	0.061	0.060	0.076	0.094	0.119
1992	0.042	0.042	0.015	0.019	0.048	0.060	0.060	0.075	0.093	0.117
1993	0.042	0.042	0.015	0.019	0.047	0.059	0.059	0.074	0.091	0.115
1994	0.043	0.043	0.015	0.018	0.046	0.058	0.057	0.073	0.089	0.113
1995	0.043	0.043	0.015	0.019	0.046	0.058	0.057	0.072	0.089	0.113
1996	0.043	0.043	0.014	0.018	0.045	0.057	0.056	0.071	0.088	0.111
1997	0.044	0.044	0.014	0.018	0.044	0.056	0.055	0.070	0.086	0.109
1998	0.044	0.044	0.014	0.018	0.044	0.056	0.054	0.069	0.085	0.108
1999	0.044	0.044	0.014	0.018	0.043	0.055	0.054	0.069	0.085	0.108
2000	0.045	0.045	0.014	0.018	0.043	0.054	0.053	0.068	0.084	0.106
Average	0.043	0.043	0.014	0.018	0.045	0.058	0.057	0.072	0.089	0.112

SCREEN 4

EEA/UNIFIED POWER SYSTEM
DEMAND AND LOSS FORECAST AT TIME OF SYSTEM PEAK (MW)

YEAR ENDING	PEAK	STATION USE	GEN CONSUM	VHV LOSS	VHV PEAK	VHV CONSUM	HV LOSS	HV PEAK	HV CONSUM	MV LOSS	MV PEAK	MV CONSUM	LV LOSS	LV PEAK
1991	7152	293.2	0.0	129.3	6729.6	1093.1	343.3	5293.2	395.3	372.1	4525.8	1418.0	368.3	2739.4
1992	7644	321.1	0.0	137.5	7185.6	1130.4	364.9	5690.3	423.5	395.6	4871.2	1525.7	391.6	2953.9
1993	8123	341.2	0.0	145.4	7636.4	1147.2	386.0	6103.2	454.2	418.4	5230.6	1643.4	414.3	3172.9
1994	8640	371.5	0.0	152.8	8115.5	1166.3	405.5	6543.7	487.0	439.7	5617.1	1769.5	435.4	3412.2
1995	9189	395.1	0.0	162.7	8631.3	1193.6	431.9	7005.8	521.5	468.3	6016.0	1902.7	463.7	3649.6
1996	9736	418.7	0.0	171.4	9146.2	1205.6	455.1	7485.4	558.9	493.5	6433.0	2047.5	488.7	3898.8
1997	10461	460.3	0.0	181.6	9819.4	1267.6	482.1	8069.7	597.9	522.9	6949.0	2199.3	518.1	4231.6
1998	11108	488.7	0.0	191.4	10427.6	1331.2	508.0	8588.4	638.9	551.1	7398.5	2359.5	546.2	4492.8
1999	11778	518.2	0.0	201.3	11058.2	1397.6	534.5	9126.1	682.5	579.9	7863.7	2530.8	574.8	4758.2
2000	12472	561.2	0.0	209.8	11700.7	1466.9	557.1	9676.7	729.0	604.6	8343.1	2713.8	599.4	5029.8

SCREEN 5

EEA/UNIFIED POWER SYSTEM
GENERATION CAPACITY COST – PEAKER METHOD (LE/KW)

PEAKING UNIT	–CAPACITY COST– MARKET	BORDER	WEIGHT	WEIGHTED COST AT BORDER
NEW–CT	811.86	798.33	1.00	798.33
WEIGHTED AVERAGE COST (LE/KW)				798.33

Assumptions for the Peaker Method:

Marginal Plant	NEW–CT
Life (years)	25
O&M and A&G (% of capital cost)	0.6%
Year Generation Required	1993
Capital Cost (LE/KW)	
Foreign	654.9
Local	327.5
Local Labor	0.0

SCREEN 6

EEA/UNIFIED POWER SYSTEM
RANKING OF GENERATING PLANTS BY VARIABLE COST – 1995

GENERATING PLANT GROUPS	TYPE	MEGAWATTS (MW) 1/	ANNUAL USE HRS/YR	VARIABLE COST $/KWH	LE/KWH	HEAT RATE BTU/KWH	FUEL COST $/MMBtu	VAR. O&M (% FUEL COST)	VAR. O&M 3/ $/KWH
BASE HYDRO 2/	B–HYD	600	–	–	–	–	–	–	–
COAL	COAL	220	7000	0.0175	0.0577	9500	1.80	2.3%	0.00039
GAS–STEAM, COMBINED CYC	GS–CC	5934	7000	0.0195	0.0643	9800	1.97	1.0%	0.00019
OLD GAS–STEAM	OLD–GS	1408	1600	0.0211	0.0696	10500	1.97	2.0%	0.00041
NEW COMBUSTION TURBINES	NEW–CT	349	1300	0.0276	0.0911	14000	1.97	0.1%	0.00003
OLD COMBUSTION TURBINES	OLD–CT	348	350	0.0316	0.1042	16000	1.97	0.2%	0.00005
PEAK HYDRO (3977 GWh) 2/	PK–HYD	1559	–	–	–	–	–	–	–

1/ For thermal plants, represents effective capacity.
2/ Installed hydro capacity = 2750 MW; dependable capacity = 2159 MW.
3/ Based on recent EEA experience.

SCREEN 7

EEA/UNIFIED POWER SYSTEM
GENERATION CAPACITY COST – "NEXT PLANT" METHOD (LE/KW)

"NEXT" UNIT	–CAPACITY COST– MARKET	BORDER	WEIGHT	WEIGHTED COST AT BORDER
COAL	2264.29	2226.55	1.00	2226.55
WEIGHTED AVERAGE COST (LE/KW)				2226.55

Assumptions for the "Next Plant" Method:

Marginal Plant	COAL
Life (years)	30
O&M and A&G (% of capital cost)	0.9%
Year Generation Required	1993
Capital Cost (LE/KW)	
Foreign	1826.5
Local	913.3
Local Labor	0.0

ASSOCIATED FUEL SAVINGS

—UNIT TYPE— NEW	DISPL	COST (LE/KWH) NEW	DISPL	HRS/YR	SAVINGS/KW
COAL	GS–CC	0.0577	0.0643	7000	46.33
GS–CC	OLD–GS	0.0643	0.0696	1600	8.45
OLD–GS	NEW–CT	0.0696	0.0911	1300	27.92
NEW–CT	OLD–CT	0.0911	0.1042	350	4.59
TOTAL FUEL SAVINGS (LE/KW/YR)					87.29

SCREEN 8

EEA/UNIFIED POWER SYSTEM
NETWORK CAPACITY COSTS (LE MILLION)

YEAR	VHV COSTS				HV COSTS			
ENDING	TOTAL	FOREIGN	LOC MAT	LOC LABOR	TOTAL	FOREIGN	LOC MAT	LOC LABOR
1991	264.81	228.13	36.67	0.00	131.25	95.91	49.65	0.00
1992	451.35	345.05	106.30	0.00	610.21	561.80	48.41	0.00
1993	224.43	202.39	22.04	0.00	582.81	518.93	63.88	0.00
1994	469.96	340.14	129.81	0.00	296.80	259.95	36.85	0.00
1995	105.26	89.69	15.57	0.00	48.46	24.56	23.90	0.00
1996	0.00	0.00	0.00	0.00	109.71	81.09	28.63	0.00
1997	9.94	6.19	3.75	0.00	91.42	66.32	25.10	0.00
1998	0.00	0.00	0.00	0.00	124.41	103.31	21.10	0.00
1999	0.00	0.00	0.00	0.00	181.89	156.42	25.47	0.00
2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

YEAR	MV COSTS				LV COSTS			
ENDING	TOTAL	FOREIGN	LOC MAT	LOC LABOR	TOTAL	FOREIGN	LOC MAT	LOC LABOR
1991	242.12	78.91	163.21	0.00	131.55	0.00	131.55	0.00
1992	265.56	92.24	173.32	0.00	136.15	0.00	136.15	0.00
1993	269.40	99.22	170.18	0.00	140.92	0.00	140.92	0.00
1994	240.08	78.15	161.94	0.00	145.85	0.00	145.85	0.00
1995	235.94	68.96	166.98	0.00	150.95	0.00	150.95	0.00
1996	236.17	71.04	165.13	0.00	156.24	0.00	156.24	0.00
1997	226.05	61.58	164.47	0.00	161.71	0.00	161.71	0.00
1998	238.87	65.60	173.27	0.00	167.37	0.00	167.37	0.00
1999	220.39	46.72	173.67	0.00	173.22	0.00	173.22	0.00
2000	41.16	41.16	0.00	0.00	0.00	0.00	0.00	0.00

SCREEN 9

EEA/UNIFIED POWER SYSTEM

VERAGE INCREMENTAL NETWORK CAPACITY COSTS BY VOLTAGE LEVEL (LE MILLION)

YEAR	VHV NETWORK					HV NETWORK				
	PEAK MW		INVESTMENT COST			PEAK MW		INVESTMENT COST		
ENDING	TOTAL	DISCOUNTED	MARKET	BORDER	DISCOUNTED	TOTAL	DISCOUNTED	MARKET	BORDER	DISCOUNTED
1991	0.00	0.00	264.81	262.97	262.97	0.00	0.00	131.25	143.09	143.09
1992	456.09	414.62	451.35	446.04	405.49	397.09	360.99	610.21	607.79	552.53
1993	450.75	372.52	224.43	223.33	184.57	412.93	341.26	582.81	579.62	479.02
1994	479.08	359.94	469.96	463.47	348.21	440.53	330.98	296.80	294.96	221.61
1995	515.82	352.31	105.26	104.48	71.36	462.04	315.58	48.46	47.26	32.28
1996	514.88	319.70	0.00	0.00	0.00	479.65	297.82	109.71	108.28	67.23
1997	673.23	380.02	9.94	9.75	5.50	504.30	329.82	91.42	90.16	50.90
1998	608.19	312.10	0.00	0.00	0.00	518.67	266.16	124.41	123.35	63.30
1999	630.59	294.17	0.00	0.00	0.00	537.72	250.85	181.89	180.62	84.26
2000	642.52	272.49	0.00	0.00	0.00	550.56	233.49	0.00	0.00	0.00
agged Total		3077.88 (1992-2000)			1278.10 (1991-99)		2726.95 (1992-2000)			1694.22 (1991-99)
	AVERAGE INCREMENTAL VHV CAPACITY COST/				415.25	AVERAGE INCREMENTAL HV CAPACITY COST/K				621.29

YEAR	MV NETWORK					LV NETWORK				
	PEAK MW		INVESTMENT COST			PEAK MW		INVESTMENT COST		
NDING	TOTAL	DISCOUNTED	MARKET	BORDER	DISCOUNTED	TOTAL	DISCOUNTED	MARKET	BORDER	DISCOUNTED
1991	0.00	0.00	242.12	233.96	233.96	0.00	0.00	131.55	124.97	124.97
1992	345.42	314.02	265.56	256.89	233.54	214.46	194.96	136.15	129.34	117.59
1993	359.38	297.01	269.40	260.89	215.61	218.99	180.99	140.92	133.87	110.64
1994	386.52	290.40	240.08	231.99	174.30	239.29	179.78	145.85	138.56	104.10
1995	398.92	272.47	235.94	227.59	155.45	237.42	162.16	150.95	143.41	97.95
1996	417.05	258.95	236.17	227.91	141.51	247.23	153.51	156.24	148.43	92.16
1997	515.96	291.25	226.05	217.83	122.96	334.79	188.98	161.71	153.62	86.72
1998	449.46	230.64	238.37	230.21	118.13	261.18	134.03	167.37	159.00	81.59
1999	465.25	217.04	220.39	211.71	98.76	265.37	123.79	173.22	164.56	76.77
2000	479.36	203.29	41.16	41.16	17.46	271.64	115.20	0.00	0.00	0.00
gged Total		2375.07 (1992-2000)			1494.22 (1991-99)		1433.41 (1992-2000)			892.48 (1991-99)
	AVERAGE INCREMENTAL MV CAPACITY COST/				629.13	AVERAGE INCREMENTAL LV CAPACITY COST/K				622.63

SCREEN 10

EEA/UNIFIED POWER SYSTEM
SUMMARY OF CAPACITY COSTS

GENERATION:	PEAKER METHOD	"NEXT PLANT"
CAPITAL COST (LE/KW)	1053.84	2939.16
(adjusted to local prices and for reserve margin and station losses at peak)		
CAPITAL COST PER YEAR (LE/KW/YR)	116.10	311.78
ASSOCIATED FUEL SAVINGS (LE/KW/YR)	-	96.03
(adjusted to local prices and for station losses)		
CAPITAL COST NET OF FUEL SAVINGS (LE/KW/YR)	116.10	215.76
O&M COST PER YEAR (LE/KW/YR)	6.74	25.86
TOTAL CAPITAL COST PER YEAR (LE/KW/YR)	122.84	241.62
CAPACITY COST PER MONTH	10.24	20.14

TRANSMISSION & DISTRIBUTION:	VHV	HV	MV	LV
CAPITAL COST (LE/KW)	437.11	653.98	662.24	655.40
(adjusted to local prices)				
CAPITAL COST PER YEAR (LE/KW/YR)	44.70	66.88	72.96	72.20
O&M COST PER YEAR (LE/KW/YR)	8.74	13.08	16.56	16.38
TOTAL CAPITAL COST PER YEAR (LE/KW/YR)	53.44	79.96	89.51	88.59
CAPACITY COST PER MONTH	4.45	6.66	7.46	7.38

SCREEN 11

EEA/UNIFIED POWER SYSTEM
STRICT LONG RUN MARGINAL COST BASED TARIFF BY VOLTAGE LEVEL

MARGINAL CAPACITY COST (LE/COINCIDENT KW/MONTH):

	GENERATION		TRANSMISSION & DISTRIBUTION					TOTAL MARGINAL CAPACITY COST	
	PEAKER METHOD	"NEXT PLANT"	VHV	HV	MV	LV	TOTAL	PEAKER METHOD	"NEXT PLANT"
VHV	10.43	20.51	4.45				4.45	14.88	24.96
HV	11.07	21.77	4.73	6.66			11.39	22.45	33.15
MV	11.92	23.45	5.09	7.18	7.46		19.73	31.65	43.17
LV	13.42	26.40	5.73	8.08	8.40	7.38	29.60	43.02	56.00

MARGINAL ENERGY COST (LE/KWH): 1/

	PEAK	OFF-PEAK
GEN	0.1002	0.0708
(adjusted to local prices and for station losses)		
VHV	0.1021	0.0718
HV	0.1082	0.0752
MV	0.1167	0.0798
LV	0.1314	0.0875

1/ Energy Costs derived directly from basic assumptions regarding marginal plant, heat rate, fuel cost, fuel heat content, and variable O&M.

SCREEN 12(A)

EEA/UNIFIED POWER SYSTEM
STRICT LONG RUN MARGINAL COST BASED TARIFF BY TARIFF CLASS – BULK

TARIFF CLASS	SERVICE VOLTAGE	COINCI-DENCE	LOAD FACTOR	ENERGY SHARES PEAK		TOTAL MARGINAL COST/MONTH CAPACITY LE/KW	ENERGY LE/KWH	TOTAL LE/KWH	DEMAND CHARGE SHARE	FY91/H1 SALES GWH	CURRENT YIELD LE/KWH
VHV INDUSTRY											
KIMA CO.	VHV	1.00	0.90	0.21		14.88	0.0782	0.1008	22%	824	0.0170
ALUMINUM CO.	VHV	0.96	0.90	0.20		14.29	0.0779	0.0996	22%	1485	0.0460
ASSUIT CEM (1)	VHV	0.95	0.90	0.20		14.14	0.0779	0.0994	22%	86	0.0632
ASSUIT CEM (2)	VHV	0.95	0.90	0.20		14.14	0.0779	0.0994	22%	59	0.0632
FERROSILICON	VHV	0.95	0.90	0.20		14.14	0.0779	0.0994	22%	153	0.0577
SOMED CO.	VHV	0.95	0.90	0.20		14.14	0.0779	0.0994	22%	162	0.0632
DEKHILA FERRO	VHV	0.95	0.90	0.20		14.14	0.0779	0.0994	22%	449	0.0632
AMERIA SPIN	VHV	0.95	0.90	0.20		14.14	0.0779	0.0994	22%	53	0.0632
HV INDUSTRY/AGRI	HV	0.95	0.70	0.20		21.33	0.0819	0.1236	34%	1218	0.0807
MV INDUSTRY/AGRI	MV	0.95	0.60	0.22		30.07	0.0879	0.1565	44%	126	0.1355
DISTRIBUTION COS.											
CAIRO	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	6449	0.0667
ALEXANDRIA	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	1619	0.0630
DELTA NORTH	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	1099	0.0514
DELTA SOUTH	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	1158	0.0542
BEHEIRA	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	716	0.0647
CANAL	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	1548	0.0644
N. UPPER EGYPT	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	1008	0.0488
S. UPPER EGYPT	HV	1.00	0.75	0.26		22.45	0.0838	0.1249	33%	1018	0.0843
EEA SYSTEM AVERAGE				0.25		21.06	0.0827	0.1207		19229	0.0608
Equivalent LE/KWH						0.0380	0.0827	0.1207			
% of System Average						31%	69%	100%			
UMMARY LRMC	VHV	1.00	1.00	1.00	0.00	14.88	0.1021	0.1225	17%		
OR EACH VOLTAGE	HV	1.00	1.00	1.00	0.00	22.45	0.1083	0.1391	22%		
to help create	MV	1.00	1.00	1.00	0.00	31.65	0.1167	0.1601	27%		
previous table)	LV	1.00	1.00	1.00	0.00	43.02	0.1314	0.1904	31%		

SCREEN 12(B)

EEA/UNIFIED POWER SYSTEM
STRICT LONG RUN MARGINAL COST BASED TARIFF BY TARIFF CLASS – RETAIL

TARIFF CLASS	SERVICE VOLTAGE	COINCI-DENCE	LOAD FACTOR	ENERGY SHARES PEAK	TOTAL MARGINAL COST/MONTH CAPACITY LE/KW	ENERGY LE/KWH	TOTAL LE/KWH	DEMAND CHARGE SHARE	FY91/H1 SALES GWH	CURRENT YIELD LE/KWH
HOUSING COS.	HV	0.95	0.75	0.26	21.33	0.0838	0.1228	32%	350	0.0600
MV MOVING POWER	MV	0.95	0.60	0.22	30.07	0.0879	0.1565	44%	3891	0.1416
LV MOVING POWER	LV	0.95	0.55	0.25	40.87	0.0985	0.2003	51%	833	0.0979
LV OTHER PURPOSE	LV	0.95	0.55	0.25	40.87	0.0985	0.2003	51%	734	0.1353
MV FREE ZONE	MV	0.95	0.60	0.22	30.07	0.0879	0.1565	44%	6	0.1264
LV FREE ZONE	LV	0.95	0.55	0.25	40.87	0.0985	0.2003	51%	6	0.1843
RESIDENTIAL	LV	0.95	0.50	0.30	40.87	0.1007	0.2126	53%	5602	0.0421
COMMERCIAL	LV	0.95	0.45	0.30	40.87	0.1007	0.2251	55%	885	0.1083
GOVT LIGHTING	LV	0.95	0.45	0.15	40.87	0.0941	0.2185	57%	286	0.1855
STREET LIGHTING	LV	1.00	0.50	0.27	43.02	0.0993	0.2172	54%	589	0.1855
DISTRIBUTION COMPANY AVERAGE				0.26	37.25	0.0960	0.1934		13183	0.0947
Equivalent LE/KWH					0.0974	0.0960	0.1934			
% of System Average					50%	50%	100%			

SCREEN 12(C)

EEA/UNIFIED POWER SYSTEM
STRICT LRMC SUMMARY BY CONSUMER GROUP

TARIFF CLASS	SERVICE VOLTAGE	FY91/H1 SALES GWH	CURRENT YIELD LE/KWH	CAPACITY COST/MONTH GEN LE/KW	NETWORK LE/KW	CAPACITY LE/KW	ENERGY COST LE/KWH	STRICT LRMC LE/KWH
VHV INDUSTRY								
KIMA CO.	VHV	824	0.0170	10.43	4.45	14.88	0.0782	0.1008
ALUMINUM CO.	VHV	1485	0.0460	10.01	4.28	14.29	0.0779	0.0996
ASSUIT CEM (1)	VHV	86	0.0632	9.91	4.23	14.14	0.0779	0.0994
ASSUIT CEM (2)	VHV	59	0.0632	9.91	4.23	14.14	0.0779	0.0994
FERROSILICON	VHV	153	0.0577	9.91	4.23	14.14	0.0779	0.0994
SOMED CO.	VHV	162	0.0632	9.91	4.23	14.14	0.0779	0.0994
DEKHILA FERRO	VHV	449	0.0632	9.91	4.23	14.14	0.0779	0.0994
AMERIA SPIN	VHV	53	0.0632	9.91	4.23	14.14	0.0779	0.0994
HV INDUSTRY/AGRI	HV	1218	0.0807	10.51	10.82	21.33	0.0819	0.1236
MV INDUSTRY/AGRI	MV	126	0.1355	11.32	18.74	30.07	0.0879	0.1565
HOUSING COS.	HV	350	0.0600	10.51	10.82	21.33	0.0838	0.1228
MV MOVING POWER	MV	3891	0.1416	11.32	18.74	30.07	0.0879	0.1565
LV MOVING POWER	LV	833	0.0979	12.75	28.12	40.87	0.0985	0.2003
LV OTHER PURPOSE	LV	734	0.1353	12.75	28.12	40.87	0.0985	0.2003
MV FREE ZONE	MV	6	0.1264	11.32	18.74	30.07	0.0879	0.1565
LV FREE ZONE	LV	6	0.1843	12.75	28.12	40.87	0.0985	0.2003
RESIDENTIAL	LV	5602	0.0421	12.75	28.12	40.87	0.1007	0.2126
COMMERCIAL	LV	885	0.1083	12.75	28.12	40.87	0.1007	0.2251
GOVT LIGHTING	LV	286	0.1855	12.75	28.12	40.87	0.0941	0.2185
STREET LIGHTING	LV	589	0.1855	13.42	29.60	43.02	0.0993	0.2172
SYSTEM AVERAGE		17797	0.0846	11.76	20.15	31.91	0.0916	0.1711
Equivalent LE/KWH				0.0293	0.0502	0.0795	0.0916	0.1711
% of System Average				17%	29%		54%	100%

SCREEN 13(A)

EEA/UNIFIED POWER SYSTEM
REVENUE RESPONSIBILITY BY CUSTOMER/TARIFF CLASS - BULK

BILLING YEAR	FY93
TOTAL GRID SALES (GWH)	19229
REVENUE REQUIREMENT	
TOTAL (LE MILLION)	1922
AVERAGE (LE/KWH) 1/	0.1000

CUSTOMER/ TARIFF CLASS	FY91/H1 SALES GWH	CURRENT YIELD2/ LE/KWH	STRICT LRMC3/ LE/KWH	REVENUE NEUTRAL STRICT LRMC LE/KWH	% CHNG	REVENUE RESPONSIBILITY LE/KWH	% CHNG
VHV INDUSTRY	3271	0.0435	0.1198	0.0827	90%	0.0862	98%
HV INDUSTRY/AGRI	1218	0.0807	0.1483	0.1023	27%	0.1483	84%
MV INDUSTRY/AGRI	126	0.1355	0.1878	0.1296	-4%	0.1878	39%
DISTRIBUTION COS.	14615	0.0624	0.1498	0.1034	66%	0.0983	58%
TOTAL EEA BULK	19229	0.0608	0.1449	0.1000	64%	0.1000	64%

1/ Approximate revenue target for FY93.
2/ Estimated average current yield after May 1991.
3/ Escalated to FY93 prices, a 20.00% increase.

SCREEN 13(B)

EEA/UNIFIED POWER SYSTEM
REVENUE RESPONSIBILITY BY CUSTOMER/TARIFF CLASS - RETAIL

BILLING YEAR	FY93
TOTAL GRID SALES (GWH)	13183
REVENUE REQUIREMENT	
TOTAL (LE MILLION)	2109
AVERAGE (LE/KWH) 1/	0.1600

CUSTOMER/ TARIFF CLASS	FY91/H1 SALES GWH	CURRENT YIELD2/ LE/KWH	STRICT LRMC3/ LE/KWH	REVENUE NEUTRAL STRICT LRMC LE/KWH	% CHNG	REVENUE RESPONSIBILITY LE/KWH	% CHNG
LARGE IND/AG	3891	0.1416	0.1878	0.1296	-8%	0.1878	33%
MEDIUM IND/AG	139	0.1202	0.2403	0.1658	38%	0.2403	100%
SMALL IND/AG	1772	0.1261	0.2439	0.1683	33%	0.2439	93%
FREE ZONE - MV	6	0.1264	0.1878	0.1296	3%	0.1878	49%
FREE ZONE - LV	6	0.1843	0.2403	0.1658	-10%	0.2403	30%
RESIDENTIAL	5602	0.0421	0.2552	0.1761	318%	0.0997	137%
COMMERCIAL	827	0.1083	0.2701	0.1864	72%	0.1864	72%
STREET LIGHTING	589	0.1855	0.2607	0.1799	-3%	0.2607	41%
SALE FOR RESALE	350	0.0600	0.1474	0.1017	69%	0.1246	108%
TOTAL DC RETAIL	13183	0.0947	0.2319	0.1600	69%	0.1600	69%

1/ Approximate revenue target for FY93.
2/ Estimated average current yield after May 1991.
3/ Escalated to FY93 prices, a 20.00% increase.

SCREEN 13(C)

EEA/UNIFIED POWER SYSTEM
REVENUE RESPONSIBILITY BY CUSTOMER/TARIFF CLASS - SYSTEM AVERAGE

BILLING YEAR	FY93
TOTAL FINAL SALES (GWH)	17797
REVENUE REQUIREMENT	
TOTAL (LE MILLION)	2521
AVERAGE (LE/KWH) 1/	0.1416

CUSTOMER/ TARIFF CLASS	FY91/H1 SALES GWH	CURRENT YIELD2/ LE/KWH	STRICT LRMC3/ LE/KWH	REVENUE NEUTRAL STRICT LRMC LE/KWH	% CHNG	REVENUE RESPONSIBILITY LE/KWH	% CHNG
VHV INDUSTRY	3271	0.0435	0.1198	0.0827	90%	0.0862	98%
HV INDUSTRY/AGRI	1218	0.0807	0.1483	0.1023	27%	0.1483	84%
MV INDUSTRY/AGRI	126	0.1355	0.1878	0.1296	-4%	0.1878	39%
LARGE IND/AG	3891	0.1416	0.1878	0.1296	-8%	0.1878	33%
MEDIUM IND/AG	139	0.1202	0.2403	0.1658	38%	0.2403	100%
SMALL IND/AG	1772	0.1261	0.2439	0.1683	33%	0.2439	93%
FREE ZONE - MV	6	0.1264	0.1878	0.1296	3%	0.1878	49%
FREE ZONE - LV	6	0.1843	0.2403	0.1658	-10%	0.2403	30%
RESIDENTIAL	5602	0.0421	0.2552	0.1761	318%	0.0997	137%
COMMERCIAL	827	0.1083	0.2701	0.1864	72%	0.1864	72%
STREET LIGHTING	589	0.1855	0.2607	0.1799	-3%	0.2607	41%
SALE FOR RESALE	350	0.0600	0.1474	0.1017	69%	0.1246	108%
TOTAL SYSTEM	17797	0.0846	0.2053	0.1416	67%	0.1458	72%

1/ System revenue requirement is 69% of strict LRMC.
2/ Estimated average current yield after May 1991.
3/ Escalated to FY93 prices, a 20.00% increase.

SCREEN 14

EEA/UNIFIED POWER SYSTEM
LRMC SENSITIVITY ANALYSIS (LE/KWH)

DISCOUNT RATE	BULK LRMC	RETAIL LRMC	SYSAVG LRMC
10%	0.1449	0.2319	0.2053
6%	0.1318	0.1988	0.1783
8%	0.1381	0.2147	0.1913
10%	0.1449	0.2319	0.2053
12%	0.1521	0.2503	0.2203

SCF	BULK LRMC	RETAIL LRMC	SYSAVG LRMC
0.95	0.1449	0.2319	0.2053
0.70	0.1926	0.2968	0.2645
0.80	0.1699	0.2660	0.2363
0.90	0.1523	0.2420	0.2145
1.00	0.1382	0.2228	0.1970

EXCHANGE RATE	BULK LRMC	RETAIL LRMC	SYSAVG LRMC
3.30	0.1449	0.2319	0.2053
3.00	0.1337	0.2180	0.1922
3.25	0.1430	0.2296	0.2031
3.50	0.1523	0.2412	0.2140
3.75	0.1616	0.2528	0.2249

YEAR GEN NEEDED	BULK LRMC	RETAIL LRMC	SYSAVG LRMC
1993	0.1449	0.2319	0.2053
1992	0.1472	0.2357	0.2086
1993	0.1449	0.2319	0.2053
1994	0.1428	0.2284	0.2022
1995	0.1408	0.2253	0.1994

GAS PRICE	BULK LRMC	RETAIL LRMC	SYSAVG LRMC
1.97	0.1449	0.2319	0.2053
1.00	0.0960	0.1752	0.1511
1.50	0.1212	0.2044	0.1790
2.00	0.1464	0.2337	0.2069
2.50	0.1716	0.2629	0.2349
3.00	0.1968	0.2921	0.2628
4.36	0.2654	0.3716	0.3387

RESERVE MARGIN	BULK LRMC	RETAIL LRMC	SYSAVG LRMC
20.0%	0.1449	0.2319	0.2053
15.0%	0.1439	0.2303	0.2039
17.5%	0.1444	0.2311	0.2046
20.0%	0.1449	0.2319	0.2053
22.5%	0.1454	0.2327	0.2060
25.0%	0.1459	0.2335	0.2067

A GUIDE FOR UPDATING THE MODEL

The foregoing sections of this guide -- flowchart, command structure, and description of individual screens within the LRMC model -- provide a useful summary of the organization and input requirements of the model. This section outlines the user-specific steps to follow when it is time to update the current base case results.

As Chapter 5 makes very clear, the model is a framework for analysis, but specific inputs are often based on judgment or extensive off-line calculation. The best source for help is the RCG/Hagler, Bailly report prepared in conjunction with the LRMC model because it discusses many of the complexities involved in determining specific input values. The following itemization summarizes points to consider, and references sections in the original report that can provide guidance when judgment is required.

(1) **Macroeconomic Assumptions:** Basic factors such as the appropriate discount rate, conversion factors, and exchange rate, are best left to trained economists, within EEA, other ARE agencies, or international lending institutions. See Chapter 3 for a discussion of planning reserve margin.

(2) **Marginal Capacity Cost Assumptions:** See Chapter 5 for a discussion of how marginal plants are chosen for the Peaker and "Next Plant" methods. Investment and maintenance costs should be agreed upon with the EEA System Planning group.

(3) **Marginal Energy Cost Assumptions:** Chapter 5 gives an overview of how the plants that provide marginal energy are identified. Actual costs depend on the operating characteristics of these plants <u>and</u> on the most current constant price fuel forecast available. Chapter 4 discusses the estimation of fuel prices used in the RCG/Hagler, Bailly study. That analysis begins with a forecast of crude oil prices in $US, and applies exchange rate forecasts and historical "spreads" among different products to forecast natural gas, mazout, and sollar prices.

(4) **Load Forecast and Losses:** The forecast -- both energy and capacity -- is an exogenous input. Chapter 2 illustrates a method for disaggregating the forecast by voltage level. Losses must also be allocated by voltage. The allocation must be assigned based on discussions between EEA load forecasters and the Transmission Planning group.

(5) **Ranking of Generating Plants for "Next Plant" Method:** Specific information required includes annual hours use, heat rate, fuel cost, and variable O&M for the major groupings of generating plant units. Again, Chapters 3 and 5 discuss the development of these data by group. Groups should be established in

conjunction with EEA system planners. If plant groups are changed from the current formulation, care must be exercised to be sure that the correct groups are referenced in the "Fuel Savings" portion of the calculation of generation capacity cost with the "Next Plant" method.

(6) Strict LRMC by Tariff Class: Many estimations are required for this analysis. It is probable that tariff categories will change before the next LRMC revision, so this table will require considerable updating. After current tariff groups are established, coincidence, load factor, and peak energy share must be defined for each group. The best sources of information for this approximation are annual and typical daily load curves for specific customers (VHV) and for feeders that predominantly service a specific tariff group. As a double check, the system peak energy share derived from these estimations should correspond to the actual system average.

Sales from a recent period (either several months or the last full year available) and current yield must be provided for each group. (Sales are used for relative weighting, so LRMC results are relatively unaffected by which recent data period is selected.)

Note that the foregoing information is required at both the bulk and retail levels; the system average is calculated automatically from that information.

(7) Revenue Responsibility by Customer/Tariff Class: To update these tables, the user must define the billing year for which tariffs are being designed. Further, the average revenue requirement at bulk (EEA), retail (EDA), and for the entire system must be provided. Great care must be exercised to see that each row (each Customer/Tariff Class) includes its share of the sales and current yield defined for each group in (6) above; in other words, total sales and total current yield must be consistent among all tables. Further, if the revenue responsibility is defined for a future year in the prices of that year, then footnote 3/ must contain the total inflation expected from the year of the analysis to that future year.

Finally, revenue responsibility should be assigned for each customer/tariff group. This judgmental assignment of responsibility is intended to consider all of the non-quantifiable factors that must ultimately be incorporated in tariff planning (e.g., Is the required percentage change reasonable? politically acceptable? socially acceptable?) Of course, the user cannot make these decisions independent of financial reality. Total revenue responsibility must still equal the average requirement at bulk, retail, and for the entire system. Thus, being generous to residential customers necessarily means over-collecting (in revenue neutral terms) from other customer groups. The actual assignment of

revenue responsibility is a policy issue for EEA to determine. As a general guide, however, no group should be asked to contribute more than its strict LRMC.