
“Know Your Customers”:

A Review of Load Research Data and Economic,
Demographic, and Appliance Saturation
Characteristics of California Utility Residential
Customers

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I. Initial Comments

This document is a work in progress given the short time frame for its production, issues in reviewing complex and data-intensive responses to data requests, and despite diligent efforts, the fact that we have been unable to receive data from PG&E. We will be augmenting the report with PG&E data and will be refining and extending analysis of the other two utilities.

JBS Energy has previously conducted a detailed study of the economic and demographic characteristics of California residential customers in 2002, largely using data from 1995.¹

We are developing this detailed analysis of economic, demographic, and appliance saturation characteristics to inform policymakers of the differences among residential customers who use more or less energy and how those differences in customer characteristics and load patterns affect the potential for demand response.

Overall, we have used three main data sources:

- Aggregate billing data
- Load Research Data
- Residential Appliance Saturation Survey (RASS) data from the latest CEC study in 2002-03

Our findings are that the demand response potential for customers under 130% of baseline is likely to be limited because the load research shows that on average, they already use proportionally less peak energy than larger customers.

The reasons for this lower peak energy use are clear when one looks at the RASS data.

Small customers have a much lower saturation of air conditioners – in the extreme case 64% of those under 130% of baseline in the SDG&E territory don't even have an air conditioner. Small customers live in small dwellings and multifamily units with shared walls that do not need as much space cooling as single-family customers.

Small customers have fewer discretionary appliances. For example, over 20% of them do not have in-home laundry facilities.

Small customers' use therefore is much more tied to non-peak appliances – refrigerators, lights, and electronic equipment.

¹ See W. Marcus, G. Ruzovan, and J. Nahigian, "Economic and Demographic Factors Affecting California Residential Energy Use," September, 2002. Available at www.jbsenergy.com.

Small customers also have considerably lower incomes than larger customers on average. Over 50% of them have incomes under \$40,000 per year on the SDG&E and Edison systems, while the largest customers (over 1500 kWh per summer month) on average earn over \$100,000.

II. Southern California Edison

A. Edison Aggregate Bill Analysis, 2005

The table below shows the distribution of Edison non-master-metered customers and energy use by rate tier for the year 2005 (where weather conditions were not unusual).

Table 1: Percentage of Customers and Energy Use by Rate Tiers, Edison, 2005

| | Tier 1 & 2 | | Tier 3 | | Tier 4 | | Tier 5 | |
|------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| | customer | energy | customer | energy | customer | energy | customer | energy |
| jan | 48.2% | 24.1% | 25.2% | 25.6% | 16.8% | 25.1% | 9.8% | 25.2% |
| feb | 53.8% | 29.5% | 24.9% | 27.5% | 14.2% | 23.2% | 7.0% | 19.8% |
| mar | 56.3% | 31.9% | 24.3% | 27.8% | 13.2% | 22.2% | 6.2% | 18.1% |
| apr | 59.6% | 34.9% | 23.2% | 27.7% | 11.9% | 20.8% | 5.4% | 16.6% |
| may | 59.7% | 34.6% | 22.7% | 26.8% | 11.9% | 20.7% | 5.8% | 17.8% |
| jun | 64.0% | 39.7% | 21.3% | 27.1% | 10.3% | 19.1% | 4.5% | 14.1% |
| jul | 55.7% | 28.9% | 22.2% | 24.6% | 13.9% | 23.1% | 8.2% | 23.4% |
| aug | 45.4% | 19.0% | 22.0% | 20.0% | 17.5% | 24.2% | 15.2% | 36.8% |
| sep | 51.3% | 25.5% | 23.4% | 24.6% | 15.6% | 24.3% | 9.7% | 25.5% |
| oct | 52.8% | 27.3% | 23.2% | 24.2% | 14.7% | 22.7% | 9.3% | 25.7% |
| nov | 56.8% | 32.0% | 23.5% | 26.8% | 13.0% | 21.8% | 6.6% | 19.4% |
| dec | 52.0% | 27.3% | 24.4% | 26.0% | 15.2% | 23.7% | 8.5% | 23.0% |
| total | 54.6% | 28.9% | 23.4% | 25.4% | 14.0% | 22.7% | 8.0% | 22.9% |
| jul-sep | 50.8% | 24.1% | 22.5% | 22.9% | 15.7% | 23.9% | 11.0% | 29.0% |
| rest of yr | 55.9% | 31.0% | 23.6% | 26.5% | 13.5% | 22.2% | 7.0% | 20.2% |

Tier 1 and 2 customers were 54.6% of customers but used 28.9% of the system energy. This relationship that customers using less than 130% of baseline use about half as much energy as their share in the number of customers is relatively consistent across utilities on an annual basis. By comparison, bills that reached Tier 4 were 14% of bills and 23% of system use Tier 5 were only 8% of total bills but 23% of use. Tier 3 bills and shares of usage were relatively similar; in other words the average user who reached tier 3 uses approximately the system average amount of electricity.

The monthly distribution of bills shows a much higher percentage of baseline bills in the shoulder months (March-June and November) than in the peak months (July-October, December and January).² In particular, the August bill had only 45% of bills below Tier

² Because bills are for a previous month's consumption, a bill contains some use in the current and previous month.

2, while 17.5% (versus 14.0% annual average) were in Tier 4 and 15.2% (versus 8% average) were in Tier 5.

From the perspective of demand response, more customers reach higher tiers in the peak summer months, so that any AB-1X protection would have less impact. However, from the perspective of customer impacts, higher use and higher bills reach a much larger number of customers in these peak summer months already.

The table below shows the use per bill by customers in each rate tier.

Table 2: Average Monthly Use Per Bill by Rate Tier (kWh), Edison 2005

| | Tier 1 | Tier 2 | Tiers 1 and 2 | Tier 3 | Tier 4 | Tier 5 | Average |
|------------|--------|--------|---------------|--------|--------|--------|---------|
| jan | 235 | 426 | 292 | 590 | 868 | 1,497 | 582 |
| feb | 222 | 398 | 273 | 551 | 811 | 1,406 | 498 |
| mar | 225 | 403 | 275 | 556 | 818 | 1,423 | 486 |
| apr | 216 | 388 | 262 | 534 | 786 | 1,374 | 447 |
| may | 217 | 389 | 262 | 535 | 789 | 1,394 | 452 |
| jun | 270 | 488 | 324 | 666 | 968 | 1,647 | 522 |
| jul | 264 | 491 | 323 | 687 | 1,034 | 1,776 | 622 |
| aug | 249 | 476 | 313 | 684 | 1,038 | 1,813 | 749 |
| sep | 265 | 494 | 329 | 695 | 1,030 | 1,742 | 661 |
| oct | 233 | 415 | 282 | 572 | 845 | 1,511 | 546 |
| nov | 233 | 416 | 282 | 571 | 841 | 1,477 | 502 |
| dec | 227 | 410 | 279 | 565 | 828 | 1,440 | 531 |
| total | 238 | 431 | 291 | 599 | 893 | 1,573 | 550 |
| jul-sep | 260 | 487 | 322 | 689 | 1,034 | 1,783 | 677 |
| rest of yr | 232 | 415 | 282 | 570 | 838 | 1,463 | 508 |

Within each rate tier, use per customer is higher in July-September than in the rest of the year. The average use by a customer who stays inside the AB1-X limit is 291 kWh per month, but 322 kWh in July-August and 282 kWh in the rest of the year. Average use by a Tier 5 customer is over 1,500 kWh per month.

The next table shows the percentage of customers by rate tier, region, basic or all-electric consumption in the peak summer months of 2005 (July-September), excluding FERA and medical baseline customers.

Table 3: Percentage of Customers by Rate Tier, by Climate Zone, Basic or All-Electric Status, and CARE and Non-CARE, Edison, July-September 2005

| BLR | Electric | Tier 1 | Tier 2 | Tiers 1 and 2 | Tier 3 | Tier 4 | Tier 5 |
|-----------------|----------|--------|--------|---------------|--------|--------|--------|
| CARE | | | | | | | |
| 10 | N | 50.9% | 17.4% | 68.2% | 20.7% | 8.4% | 2.6% |
| 10 | Y | 55.7% | 15.9% | 71.6% | 19.3% | 7.3% | 1.8% |
| 13 | N | 46.2% | 17.0% | 63.2% | 22.6% | 10.5% | 3.7% |
| 13 | Y | 77.3% | 10.2% | 87.5% | 9.0% | 2.8% | 0.7% |
| 14 | N | 37.2% | 17.3% | 54.5% | 25.9% | 13.7% | 5.9% |
| 14 | Y | 65.9% | 12.6% | 78.5% | 14.0% | 5.7% | 1.8% |
| 15 | N | 42.3% | 14.6% | 57.0% | 21.5% | 12.7% | 8.8% |
| 15 | Y | 77.1% | 11.0% | 88.0% | 9.2% | 2.4% | 0.4% |
| 16 | N | 37.0% | 16.0% | 53.0% | 24.7% | 14.7% | 7.6% |
| 16 | Y | 53.8% | 15.4% | 69.2% | 19.2% | 8.8% | 2.8% |
| 17 | N | 48.8% | 16.8% | 65.7% | 21.3% | 9.5% | 3.5% |
| 17 | Y | 75.7% | 10.5% | 86.2% | 9.7% | 3.1% | 0.9% |
| All | | 50.0% | 16.6% | 66.7% | 20.9% | 9.2% | 3.3% |
| DOMESTIC | | | | | | | |
| 10 | N | 34.9% | 14.9% | 49.8% | 24.8% | 15.6% | 9.9% |
| 10 | Y | 57.8% | 14.7% | 72.5% | 17.4% | 7.1% | 3.0% |
| 13 | N | 32.6% | 13.8% | 46.5% | 25.4% | 18.3% | 9.8% |
| 13 | Y | 59.3% | 12.8% | 72.1% | 16.4% | 8.0% | 3.4% |
| 14 | N | 31.6% | 14.8% | 46.4% | 27.4% | 17.5% | 8.7% |
| 14 | Y | 63.5% | 12.4% | 75.9% | 14.8% | 6.7% | 2.6% |
| 15 | N | 39.4% | 11.0% | 50.4% | 18.6% | 14.0% | 17.0% |
| 15 | Y | 77.8% | 8.8% | 86.6% | 9.0% | 3.3% | 1.2% |
| 16 | N | 48.0% | 11.1% | 59.1% | 19.7% | 13.1% | 8.1% |
| 16 | Y | 67.5% | 10.6% | 78.1% | 13.3% | 6.3% | 2.3% |
| 17 | N | 31.6% | 14.8% | 46.5% | 25.8% | 17.4% | 10.3% |
| 17 | Y | 47.0% | 14.3% | 61.2% | 21.0% | 11.6% | 6.1% |
| All | | 36.6% | 14.6% | 51.2% | 24.2% | 15.4% | 9.3% |

The table shows that large numbers of CARE customers are within Tiers 1 and 2 – 66% of CARE customers vs. 51% of ordinary domestic customers. The largest percentages of customers staying within the baseline allowances in peak summer months are found among all-electric customers. Among non-CARE customers, a slightly higher percentage of basic customers stay within the AB-1X in Zone 15 in the peak summer months, in all likelihood because that region has four-month summer and eight-month non-summer baseline seasons. Despite higher baseline allowances, the largest percentage of Tier 5 users is found in Zone 15; approximately 10% of non-CARE basic customers in coastal zone 10 and inland zone 17 are also in Tier 5.

B. Analysis of Edison Load Research Data

Load research information provided by SCE for the year 2006 demonstrates the percentage of summer on-peak energy use increases and the load factor decreases as usage goes up.

We compiled and calculated a series of statistics. Our analysis excluded master-metered customers, customers on voluntary time of use rates. We also excluded customers with incomplete data records (less than 115 of 122 summer days and less than 220 of 243 winter days, no data for both the system and class peak, and consumption of less than 200 kWh (50 kWh per month) in the four summer months).³ For those data that were retained with less than the total number of summer or winter days) data were adjusted to reflect a full number of summer and winter days.

Information compiled from the data include:

- the average hourly use during the four summer months,
- average hourly use in the other eight non-summer months,
- average hourly annual usage
- average hourly use in the on-peak period (using two definitions – the “marginal cost definition of noon to 6 pm on weekdays, and the “AMI” definition of 2 pm to 6 pm on weekdays) and the remainder of the summer (non-peak).
- Customer load at the time of the system coincident peak
- Customer load at the time of the residential class non-coincident peak

Further summary statistics were produced from the data including:

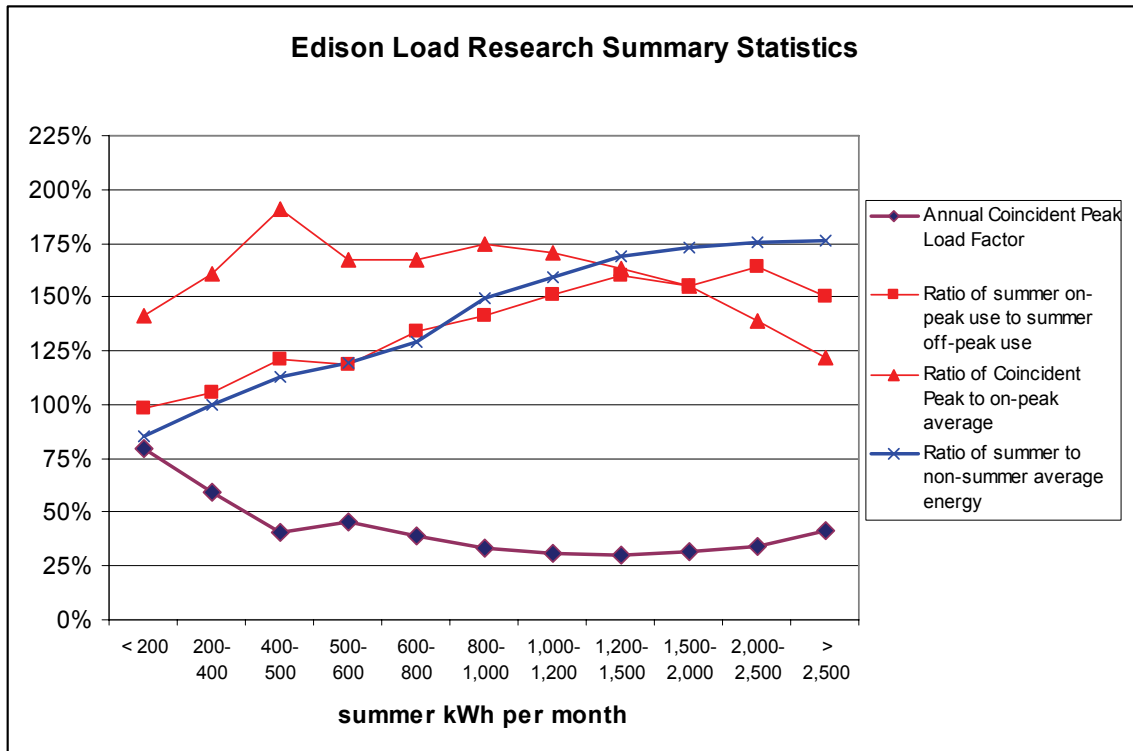
- Percentage of summer energy used in the on-peak hours
- Summer on-peak energy as a percentage of summer non-peak energy.
- Coincident peak hour load as a percentage of summer on-peak energy

³ More winter days were allowed to be incomplete because the main focus of the analysis was on the summer months.

- Summer and annual load factors based on coincident peak and annual load factor based on class non-coincident peak.⁴
- Summer average use as a percentage of non-summer average use

The chart below shows some summary statistics, which are backed up by a table immediately following that shows more detailed load research results by average monthly usage in the four summer months of June-September.

Figure 1: Edison Load Research Summary Statistics



⁴ The load factor is the average hourly load during a period divided by the peak load.

Table 4: Detailed Edison Load Research Statistics by Usage Level

| June-Sept average use (kWh) | ≤ 200 | 200-400 | 400-500 | 500-600 | 600-800 | 800-1,000 | 1,000-1,200 | 1,200-1,500 | 1,500-2,000 | 2,000-2,500 | ≥ 2,500 | ALL CUSTOMERS |
|--|--------|---------|---------|---------|---------|-----------|-------------|-------------|-------------|-------------|---------|---------------|
| % of customers | 10.1% | 23.7% | 11.4% | 10.3% | 13.9% | 9.6% | 6.4% | 6.4% | 6.0% | 1.7% | 0.6% | 100.0% |
| AVERAGE MONTHLY USE | | | | | | | | | | | | |
| Summer On-peak (marginal cost definition) | 24 | 54 | 90 | 107 | 150 | 201 | 257 | 329 | 415 | 560 | 861 | 153 |
| Summer on-peak (AMI definition) | 17 | 38 | 64 | 76 | 107 | 143 | 186 | 239 | 297 | 394 | 599 | 109 |
| Summer off-peak (AMI definition) | 127 | 264 | 388 | 472 | 589 | 748 | 911 | 1,107 | 1,414 | 1,782 | 2,949 | 582 |
| Summer all time periods | 144 | 302 | 451 | 547 | 696 | 891 | 1,097 | 1,345 | 1,711 | 2,176 | 3,548 | 692 |
| 8 Non-summer months | 168 | 300 | 397 | 456 | 538 | 595 | 688 | 794 | 987 | 1,234 | 2,006 | 498 |
| HOURLY USE | | | | | | | | | | | | |
| Summer On-peak (marginal cost definition) | 0.19 | 0.41 | 0.69 | 0.82 | 1.15 | 1.53 | 1.97 | 2.52 | 3.18 | 4.28 | 6.59 | 1.17 |
| Summer on-peak (AMI definition) | 0.19 | 0.43 | 0.73 | 0.87 | 1.23 | 1.64 | 2.14 | 2.74 | 3.41 | 4.52 | 6.87 | 1.25 |
| Summer off-peak (AMI definition) | 0.20 | 0.41 | 0.60 | 0.73 | 0.91 | 1.16 | 1.41 | 1.72 | 2.19 | 2.76 | 4.57 | 0.90 |
| Summer all time periods | 0.20 | 0.41 | 0.62 | 0.75 | 0.95 | 1.22 | 1.50 | 1.84 | 2.34 | 2.97 | 4.85 | 0.95 |
| 8 Non-summer months | 0.23 | 0.41 | 0.55 | 0.63 | 0.74 | 0.82 | 0.94 | 1.09 | 1.35 | 1.69 | 2.75 | 0.68 |
| Annual Average | 0.22 | 0.41 | 0.57 | 0.67 | 0.81 | 0.95 | 1.13 | 1.34 | 1.68 | 2.12 | 3.45 | 0.77 |
| Coincident peak | 0.27 | 0.70 | 1.39 | 1.46 | 2.06 | 2.87 | 3.65 | 4.48 | 5.28 | 6.26 | 8.39 | 2.05 |
| Residential class non-coincident peak | 0.29 | 0.71 | 1.28 | 1.38 | 2.31 | 3.04 | 3.90 | 4.75 | 5.17 | 7.10 | 9.05 | 2.13 |
| % of summer energy in MC on-peak | 17.0% | 17.8% | 20.0% | 19.5% | 21.5% | 22.5% | 23.4% | 24.5% | 24.3% | 25.7% | 24.3% | 22.2% |
| % of summer energy in AMI on-peak | 11.8% | 12.5% | 14.1% | 13.8% | 15.4% | 16.1% | 17.0% | 17.7% | 17.4% | 18.1% | 16.9% | 15.8% |
| Ratio of summer AMI on-peak use to summer average use | 98.7% | 105.2% | 118.3% | 116.3% | 129.1% | 134.9% | 142.6% | 149.1% | 145.8% | 152.1% | 141.7% | 132.8% |
| Ratio of summer AMI on-peak use to summer AMI off-peak use | 98.6% | 106.0% | 121.3% | 118.9% | 134.4% | 141.5% | 151.3% | 159.7% | 155.5% | 163.7% | 150.2% | 138.9% |
| Ratio of Coincident Peak to AMI-on-peak average | 141.2% | 160.8% | 191.1% | 167.6% | 167.6% | 174.9% | 170.7% | 163.6% | 155.0% | 136.5% | 122.1% | 163.7% |
| Ratio of summer to non-summer average energy | 85.6% | 100.2% | 113.1% | 119.1% | 128.9% | 149.1% | 158.8% | 166.8% | 172.6% | 175.6% | 176.2% | 138.2% |
| Summer Coincident Peak Load Factor | 72% | 59% | 44% | 51% | 46% | 42% | 41% | 41% | 44% | 47% | 56% | 46% |
| Annual Coincident Peak Load Factor | 80% | 59% | 41% | 46% | 39% | 33% | 31% | 30% | 32% | 34% | 41% | 38% |
| Annual Class Peak Load Factor | 67% | 58% | 48% | 54% | 41% | 40% | 38% | 39% | 45% | 42% | 54% | 44% |
| % of peaked customers | 22% | 28% | 40% | 46% | 60% | 73% | 79% | 86% | 85% | 90% | 87% | 51% |

We find that:

1. 45.2% of residential customers using an average of less than 500 kWh per month in the four summer months. These customers use only 19.9% of summer energy, 16.4% of summer peak energy (AMI definition), and 17.1% of coincident peak load. They use 23.8% of the annual residential consumption because they use relatively more power in the winter months than other residential customers.
2. The percentage of residential summer energy used during the on-peak hours increases relatively consistently from 200-2500 kWh; very large customers appear to have a slightly better load factor than other large customers, but it is still considerably worse than that for most small customers.
3. On the Edison system, unlike SDG&E, use is considerably higher in the winter than in the summer. The average customer in the load research study uses 692 kWh per month in the summer and 498 kWh per month in the winter – 33% more energy in the summer. However, the ratio of summer to winter use increases consistently as summer usage goes up. The smallest summer users use 15% less in the summer than the winter; the largest use 76% more in the summer.
4. The summer load factor declines as usage increases up to about 800 kWh per month; it then levels off to about 1500 kWh per month and increases among the very largest customers. The same trend is apparent for the annual load factor, but the annual load factor is worse. The decline up to 800 kWh is sharper and the winter load factor is flat up to 2500 kWh because of the increases in summer use relative to winter use as load goes up. Only the few customers over 2500 kWh have a better load factor than others; though it still is not as good in the aggregate as the load factor for customers under 600 kWh.

In sum, small customers use less peak period energy and less energy at the time of system peak, relative to their energy consumption.

Relative to an Edison customer using less than 400 kWh per month, the average Edison customer using more than 2000 kWh per month uses:

- 9.9 times as much summer energy
- 14.1 times as much summer on-peak energy
- 11.9 times as much summer coincident peak power
- 12.9 times as much residential class peak power, but only
- 9.3 times as much summer off-peak energy
- 5.5 times as much winter energy

We also collected the same data for several other groups – CARE customers, customers who signed up for Edison’s APS (load management) program, Edison employees, and all-electric customers. Little out of the ordinary was found for these groups.

CARE customers used less than non-CARE customers and had a 4% higher annual load factor. APS customers and Edison employees used more than average and had a lower load factor. Finally, we found much higher load factors for all-electric customers than basic customers of the same size; this can be expected because the all-electric customers have baseload water heating and winter heating usage, which gives them a better summer load factor as well as a lower ratio of summer to winter use.

Table 5: Detailed Edison Load Research Statistics by Customer Type

| | ALL CUSTOMERS | CARE | Non-CARE | APS | Non-APS | Employee | Non-Employee | All-Electric | Basic |
|--|---------------|-------|----------|-------|---------|----------|--------------|--------------|-------|
| June-Sept average use (kWh) | 100.0% | 27.2% | 72.8% | 6.4% | 93.6% | 4.9% | 95.1% | 12.1% | 87.9% |
| % of customers | | | | | | | | | |
| AVERAGE MONTHLY USE | | | | | | | | | |
| Summer On-peak (marginal cost definition) | 153 | 130 | 162 | 258 | 146 | 239 | 149 | 128 | 157 |
| Summer on-peak (AMI definition) | 109 | 92 | 116 | 187 | 104 | 172 | 106 | 90 | 112 |
| Summer off-peak (AMI definition) | 582 | 504 | 612 | 862 | 563 | 820 | 570 | 527 | 590 |
| Summer all time periods | 692 | 596 | 727 | 1,049 | 668 | 992 | 676 | 617 | 702 |
| | | 82% | | | | | | | |
| 8 Non-summer months | 498 | 429 | 524 | 672 | 487 | 682 | 489 | 574 | 488 |
| | | 82% | | | | | | | |
| HOURLY USE | | | | | | | | | |
| Summer On-peak (marginal cost definition) | 1.17 | 0.99 | 1.24 | 1.98 | 1.12 | 1.83 | 1.14 | 0.98 | 1.20 |
| Summer on-peak (AMI definition) | 1.25 | 1.06 | 1.33 | 2.14 | 1.19 | 1.97 | 1.22 | 1.03 | 1.29 |
| Summer off-peak (AMI definition) | 0.90 | 0.78 | 0.95 | 1.34 | 0.87 | 1.27 | 0.88 | 0.82 | 0.91 |
| Summer all time periods | 0.95 | 0.81 | 0.99 | 1.43 | 0.91 | 1.36 | 0.92 | 0.84 | 0.96 |
| 8 Non-summer months | 0.68 | 0.59 | 0.72 | 0.92 | 0.67 | 0.93 | 0.67 | 0.79 | 0.67 |
| Annual Average | 0.77 | 0.66 | 0.81 | 1.09 | 0.75 | 1.08 | 0.76 | 0.81 | 0.77 |
| | | | | | | | | | |
| Coincident peak | 2.05 | 1.64 | 2.21 | 3.68 | 1.94 | 3.44 | 1.98 | 1.46 | 2.13 |
| Residential class non-coincident peak | 2.13 | 1.61 | 2.33 | 3.55 | 2.04 | 3.23 | 2.08 | 1.64 | 2.20 |
| | | | | | | | | | |
| % of summer energy in MC on-peak | 22% | 22% | 22% | 25% | 22% | 24% | 22% | 21% | 22% |
| % of summer energy in AMI on-peak | 16% | 15% | 16% | 18% | 16% | 17% | 16% | 15% | 16% |
| Ratio of summer AMI on-peak use to summer average use | 135% | 130% | 134% | 150% | 131% | 145% | 132% | 122% | 134% |
| Ratio of summer AMI on-peak use to summer AMI off-peak use | 139% | 135% | 140% | 160% | 137% | 155% | 138% | 126% | 141% |
| Ratio of Coincident Peak to AMI-on-peak average | 164% | 155% | 166% | 172% | 163% | 175% | 163% | 142% | 166% |
| Ratio of summer to non-summer average energy | 136% | 138% | 138% | 155% | 137% | 145% | 136% | 107% | 143% |
| | | | | | | | | | |
| Summer Coincident Peak Load Factor | 46% | 50% | 45% | 39% | 47% | 39% | 47% | 58% | 45% |
| Annual Coincident Peak Load Factor | 36% | 40% | 37% | 30% | 39% | 31% | 36% | 55% | 36% |
| Annual Class Peak Load Factor | 44% | 50% | 43% | 40% | 45% | 42% | 44% | 52% | 44% |
| | | | | | | | | | |
| % of peaked customers | 51% | 51% | 51% | 66% | 50% | 56% | 51% | 30% | 54% |

C. Analysis of SCE RASS Data

SCE data was also provided from the Residential Appliance Saturation Survey (RASS) matched to billing data. The data were from 2002, unlike the later load research data. However, the RASS data and the load research data reach the same conclusions – that small customers’ contributions to demand response will be minimal.

The RASS data explain why the load research results show what they show - considerably less peak period energy use among small summer energy users than among larger users.

The RASS data were collected in 2002-2003. Data were first screened to remove (1) seasonally occupied dwellings; (2) customers without complete kWh sales data for 2002; and (3) customers using less than 50 kWh per month in any of the four months of June-September, 2002 (to remove very unusual customers or poor data).

We ran data for the entire company as well as three separate climate regions – cool (Zones 6,8, and 162), mid-range (Zones 5 and 9), and hot (Zones 13, 14, and 102). We examined Zone 15 (low desert) but did not analyze it because of a limited number of data points (157), a climate that was dramatically different than the rest of the service area, and what appears to be some miscoded vacation homes.

We focused on use in the four peak summer months of June-September because this is the time frame when critical peak pricing programs would be operative.

The RASS sample showed the following information on customer usage in June-September versus the remainder of the year.

Table 6: Customers, Use, and Peaked Seasonal Use by Summer Tier, Edison Customers

| | Average monthly summer use (kWh) | | | | | Over 425 kWh | |
|--------------------------|----------------------------------|---------|---------|-------|-------|--------------|-------|
| | <425 | 425-600 | 600-900 | >900 | >1500 | Average | |
| % of customers | 39.5% | 19.7% | 19.7% | 17.6% | 3.5% | | |
| average kWh summer month | 271 | 508 | 734 | 1,142 | 1,906 | 847 | 620 |
| avg kWh non-summer month | 284 | 471 | 586 | 774 | 1,247 | 641 | 500 |
| % peaked * | 17.0% | 35.0% | 54.1% | 77.9% | 79.5% | 56.3% | 40.8% |

Customers using less than 425 kWh (approximately equal to 130% of baseline in the cooler coastal climate zones but less than 130% of baseline in warmer zones) were numerous (almost 40% of the customers), but they used only 43% of the average summer energy over all residential customers and 32% of the energy of customers over 425 kWh. These smaller customers were concentrated in the cooler and mid-range climate areas.

The sample indicated that the small customers accounted for 17% of the summer energy used by Edison residential customers, with 83% of the energy used by the 60% of customers who exceeded 425 kWh.

Unlike SDG&E, where winter use was roughly equivalent to summer use, this equivalence was only seen for Edison among small customers, who used 5% more in winter than in summer. The average summer use among Edison’s customers who used more than 425 kWh was 32% higher than the average winter use. On a total system basis, summer use was 24% higher than winter use.

Customers using less than 425 kWh per month in the peak summer months also had flatter annual load patterns than other Edison customers; only 17% used 30+% more in July-September than in the shoulder months of March and April (PG&E’s proxy definition for determining whether a customer has significant air conditioning load). Edison’s overall load patterns were considerably less flat, with peaked load patterns for 56.3% of its customers using more than 425 kWh per summer month, so small customers stand out in this regard.

Data for the three Edison climate zones are given below.

Table 7: Customers, Use, and Peaked Seasonal Use by Summer Tier, Edison Cool Climate Customers

| | <425 | 425-600 | 600-900 | >900 | >1500 | Over 425 kWh | Average |
|-----------------------------|-------|---------|---------|-------|-------|-----------------|---------|
| % of customers | 52.4% | 20.4% | 18.0% | 7.0% | 1.1% | | |
| average summer kWh/ month | 271 | 500 | 722 | 1,117 | 1,823 | 710 | 472 |
| average nonsummer kWh/month | 296 | 513 | 661 | 954 | 2,436 | 682 | 472 |
| % peaked * | 10.4% | 19.3% | 32.5% | 49.6% | 58.3% | 29.9% | 19.4% |

* peaked load pattern is an average summer load > 130% of the shoulder loads in March-April

Table 8: Customers, Use, and Peaked Seasonal Use by Summer Tier, Edison Mid Climate Customers

| | <425 | 425-600 | 600-900 | >900 | >1500 | Over 425 kWh | Average |
|-----------------------------|-------|---------|---------|-------|-------|-----------------|---------|
| % of customers | 39.2% | 20.1% | 20.7% | 12.9% | 3.6% | | |
| average summer kWh/month | 271 | 512 | 736 | 1,129 | 2,011 | 825 | 579 |
| average nonsummer kWh/month | 268 | 451 | 600 | 833 | 2,367 | 710 | 512 |
| % peaked * | 22.8% | 44.9% | 55.3% | 73.6% | 77.5% | 57.2% | 41.7% |

Table 9: Customers, Use, and Peaked Seasonal Use by Summer Tier, Edison Hot Climate Customers

| | <425 | 425-600 | 600-900 | >900 | >1500 | Over 425 kWh | Average |
|-----------------------------|-------|---------|---------|-------|-------|-----------------|---------|
| % of customers | 19.7% | 19.3% | 21.9% | 26.1% | 6.5% | | |
| average summer kWh/month | 273 | 520 | 748 | 1,150 | 1,864 | 929 | 739 |
| average nonsummer kWh/month | 256 | 414 | 484 | 690 | 2,117 | 683 | 554 |
| % peaked * | 39.0% | 55.4% | 81.6% | 90.4% | 82.3% | 78.0% | 65.2% |

As the climate becomes warmer, the percentage of small users declines, the ratio of summer to winter use, and the percentage of peaked users increases. However, in all climate zones, small users continue to have less peaky load patterns than others and a higher ratio of summer to winter loads. (Small users in the Coastal zone show an opposite pattern, where winter loads are higher than summer).

The reason for lower usage and flatter usage patterns among small customers becomes obvious from appliance saturation and housing size data. We start with housing characteristic and square footage data.

**Table 10: Type of Dwelling and Ownership by Baseline Tier
Edison Residential Customers**

| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 425 kWh | Average |
|---------------|-------|---------|---------|----------|-------|-----------------|---------|
| single family | 51.5% | 79.0% | 78.0% | 87.9% | 92.2% | 81.0% | 65.1% |
| multifamily | 46.9% | 18.9% | 19.3% | 7.8% | 7.3% | 16.3% | 32.8% |
| mobile home * | 1.6% | 2.2% | 2.7% | 3.3% | 0.5% | 2.5% | 2.0% |
| rent | 45.0% | 20.6% | 19.8% | 13.6% | 8.7% | 18.4% | 32.7% |
| own | 55.0% | 79.4% | 80.2% | 86.4% | 91.3% | 81.6% | 67.3% |
| rent MF | 34.6% | 12.0% | 12.3% | 5.0% | 6.1% | 10.5% | 23.5% |
| own MF | 11.6% | 6.7% | 8.1% | 2.0% | 1.4% | 6.0% | 9.0% |
| rent SF | 10.3% | 8.6% | 7.4% | 8.6% | 2.6% | 7.9% | 9.2% |
| own SF | 43.5% | 72.7% | 72.1% | 84.4% | 89.9% | 75.6% | 58.3% |

* in the remainder of this analysis, mobile homes are included with single family because their energy use characteristics are similar to single family.

Far more small customers live in multifamily housing than large customers – 47% vs. only 16% using more than 425 kWh per month. While 53% of small customers live in single-family homes (including mobile homes), this is far less than the 83% of customers using more than 425 kWh or the 91% of customers using more than 900 kWh.

In addition, far more small customers are renters – which means that they would find it difficult to make investments to save energy (e.g., better appliances and tighter building envelope) in response to pricing programs.

There are some differences in the type of housing by climate zone, with multifamily housing diminishing as one moves away from the coast. A significant number of mobile homes appear in the hottest more rural regions. Nevertheless, small customers (under 425 kWh per month) are always less likely than other groups to live in single-family homes.

Table 11: Type of Dwelling by Usage Tier, Edison Cool Climate

| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 425 kWh | Average |
|---------------|-------|---------|---------|----------|-------|--------------|---------|
| single family | 45.4% | 76.8% | 80.5% | 87.9% | 96.5% | 80.4% | 61.2% |
| multifamily | 53.8% | 22.4% | 18.5% | 6.7% | 1.0% | 18.0% | 36.6% |
| mobile home | 0.8% | 0.8% | 1.0% | 4.0% | 2.5% | 1.4% | 1.1% |

Table 12: Type of Dwelling by Usage Tier, Edison Mid Climate

| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 425 kWh | Average |
|---------------|-------|---------|---------|----------|-------|--------------|---------|
| single family | 59.6% | 84.0% | 84.0% | 85.7% | 97.3% | 85.2% | 72.2% |
| multifamily | 39.4% | 13.8% | 15.7% | 11.1% | 2.7% | 13.2% | 23.0% |
| mobile home | 1.0% | 2.2% | 0.4% | 0.0% | 0.0% | 0.9% | 0.9% |

Table 13: Type of Dwelling by Usage Tier, Edison Hot Climate

| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 425 kWh | Average |
|---------------|-------|---------|---------|----------|-------|--------------|---------|
| single family | 80.4% | 74.3% | 92.0% | 92.0% | 98.3% | 87.9% | 80.7% |
| multifamily | 25.6% | 14.8% | 18.6% | 3.8% | 1.7% | 10.9% | 13.1% |
| mobile home | 6.7% | 4.8% | 7.1% | 4.2% | 0.0% | 4.8% | 4.9% |

The square footage results are given below on a system-wide basis and further summarized by dwelling type.

Table 14: Square Footage and Type of Dwelling by Usage Tier, Edison Customers

| | Average monthly summer use (kWh) | | | | | Over 425 | Average |
|--------------------|----------------------------------|---------|---------|----------|-------|----------|---------|
| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | kWh | |
| <500 sf | 6.9% | 2.0% | 1.1% | 0.1% | 0.0% | 1.2% | 4.3% |
| 500-750 | 11.6% | 2.8% | 3.0% | 0.3% | 0.2% | 2.2% | 7.3% |
| 750-1000 | 20.0% | 9.6% | 7.9% | 4.5% | 0.1% | 7.6% | 14.3% |
| 1000-1250 | 19.0% | 15.9% | 13.5% | 8.8% | 5.9% | 13.2% | 16.3% |
| 1250-1500 | 16.4% | 20.4% | 17.6% | 15.3% | 11.9% | 18.1% | 17.2% |
| 1500-2000 | 15.4% | 22.5% | 29.9% | 34.7% | 15.7% | 27.0% | 20.8% |
| 2000-2500 | 6.3% | 15.0% | 15.3% | 21.4% | 24.8% | 16.8% | 11.1% |
| 2500-3000 | 3.0% | 10.4% | 7.5% | 9.2% | 16.6% | 9.5% | 6.0% |
| 3000-4000 | 0.8% | 1.3% | 3.3% | 4.7% | 17.6% | 3.4% | 2.0% |
| > 4000 sf | 0.6% | 0.1% | 0.9% | 1.0% | 7.2% | 0.9% | 0.7% |
| avg square feet | 1,248 | 1,637 | 1,716 | 1,908 | 2,510 | 1,758 | 1,484 |
| <1000 sq ft mf | 27.1% | 8.1% | 8.6% | 2.8% | 0.2% | 6.8% | 17.7% |
| <1000 sq ft sf | 11.4% | 6.3% | 3.5% | 2.1% | 0.1% | 4.3% | 8.1% |
| 1000-1500 sq ft mf | 12.1% | 7.2% | 6.3% | 1.9% | 6.0% | 5.8% | 9.2% |
| 1000-1500 sq ft sf | 23.3% | 29.0% | 24.8% | 22.1% | 11.8% | 25.5% | 24.3% |
| > 1500 sq ft mf | 4.0% | 3.0% | 4.8% | 2.5% | 1.4% | 3.4% | 3.7% |
| > 1500 sq ft sf | 22.1% | 46.3% | 52.1% | 68.5% | 80.5% | 54.2% | 36.9% |

Over 38% of small customers live in dwellings under 1000 square feet, with 35% in 1000-1500 square feet and only 26% over 1500 square feet, and 1% above 3000 square feet. By comparison, among customers using more than 425 kWh, only 11% live in dwellings under 1000 square feet; 31% in 1000-1500 square feet, 57% above 1500 Square feet, and 4% over 3000 square feet. A larger proportion of very large customers live in very large homes, with over 24% of customers whose bills reach Tier 5 (over 900 kWh/month roughly) living in more than 2500 square feet.

Next we turn to saturation of energy-consuming equipment that is particularly amenable to demand response.

Table 15: Air Conditioner, Swimming Pool, and Laundry Saturation by Summer Tier, Edison Customers

| | Average monthly summer use (kWh) | | | | | Over 425 | Average |
|----------------|----------------------------------|---------|---------|----------|-------|----------|---------|
| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | kWh | |
| central a/c | 27.0% | 48.9% | 61.4% | 84.9% | 92.5% | 62.2% | 43.2% |
| no a/c | 50.8% | 31.3% | 19.5% | 4.9% | 3.6% | 20.9% | 37.0% |
| room/evap a/c | 25.5% | 23.8% | 22.4% | 20.1% | 11.6% | 22.0% | 23.9% |
| pool | 1.0% | 9.3% | 13.1% | 26.7% | 48.0% | 15.8% | 7.9% |
| home laundry | 74.5% | 91.0% | 94.3% | 98.5% | 97.2% | 93.8% | 83.4% |
| electric stove | 6.6% | 7.1% | 8.5% | 7.7% | 12.6% | 8.0% | 7.2% |

The saturation of air conditioning is considerably higher on the Edison system than for SDG&E. Over 43% of Edison customers have central air conditioning, and another 24%

have room air conditioning or evaporative cooling. However, there is still a large difference between small customers and others, with 50% of small customers having no air conditioning (compared to 21% of those using more than 425 kWh). The percentage of central air conditioning rises as usage increases, from 27% of small customers to over 92% of customers using 1500 kWh per month. The percentage of swimming pools among small customers is a trivial 1%, compared to 16% among customers exceeding 425 kWh and 48% of very large customers using 1500 kWh per month. While most customers have home laundry equipment, only 74% of small customers have it compared to 94% of customers using over 425 kWh. Electric stoves are not prevalent on the Edison system (only 7% saturation), and a slightly lower proportion of small customers have them than the proportion in larger usage groups.

The air conditioner saturation varies by climate zone, with a bare majority even of small customers in the hot climate zones having central air conditioning.

Table 16: Air Conditioner, Saturation by Summer Tier, Edison Cool Zone Customers

| <u>Approximate rate tier</u> | Average monthly summer use (kWh) | | | | | Over 425 | Average |
|------------------------------|----------------------------------|---------------------|---------------------|----------------------|---------------------|----------|---------|
| | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | 900-1500 5th Tier | >1500 Very large | kWh | |
| central a/c | 20.2% | 32.5% | 44.0% | 66.1% | 92.1% | 43.4% | 30.8% |
| no a/c | 64.4% | 52.0% | 35.7% | 19.9% | 2.9% | 39.7% | 52.2% |
| room/evap a/c | 17.3% | 17.4% | 20.9% | 18.9% | 9.2% | 18.8% | 17.8% |

Table 17: Air Conditioner, Saturation by Summer Tier, Edison Mid Zone Customers

| | Average monthly summer use (kWh) | | | | | Over 425 | Average |
|---------------|----------------------------------|---------|---------|----------|-------|----------|---------|
| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | kWh | |
| central a/c | 32.2% | 61.5% | 71.4% | 94.4% | 96.1% | 74.6% | 55.3% |
| no a/c | 30.8% | 20.2% | 10.3% | 0.4% | 0.8% | 11.0% | 18.3% |
| room/evap a/c | 42.3% | 22.9% | 22.8% | 25.1% | 19.5% | 23.1% | 29.8% |

Table 18: Air Conditioner, Saturation by Summer Tier, Edison Hot Zone Customers

| | Average monthly summer use (kWh) | | | | | Over 425 | Average |
|---------------|----------------------------------|---------|---------|----------|-------|----------|---------|
| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | kWh | |
| central a/c | 50.5% | 67.6% | 77.6% | 93.5% | 92.1% | 81.9% | 70.3% |
| no a/c | 18.9% | 3.4% | 4.7% | 0.1% | 5.5% | 2.8% | 5.8% |
| room/evap a/c | 37.3% | 37.3% | 22.9% | 15.9% | 7.6% | 22.8% | 24.2% |

While 28% of small customers actually have central air conditioning overall⁵ (compared to 63% of customers using more than 425 kWh and almost 90% of Tier 5 customers), those with central air conditioning also have much smaller dwellings than customers who end up above 425 kWh.

Table 19: Air Conditioner Saturation and Size and Type of Dwelling by Summer Tier, Edison Customers

| Approximate rate tier | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | 900-1500 5th Tier | >1500 Very large | Over 130% BL | Average |
|------------------------------|------------------|---------------------|---------------------|----------------------|---------------------|-----------------|---------|
| central air | 27.7% | 49.7% | 61.3% | 84.4% | 95.0% | 62.5% | 43.8% |
| MF under 1000 sf | 4.5% | 2.0% | 6.3% | 1.9% | 0.0% | 3.3% | 4.0% |
| SF under 1000 sf | 1.0% | 1.1% | 1.1% | 1.3% | 0.1% | 1.0% | 1.0% |
| MF 1000-1500 | 5.4% | 4.8% | 6.1% | 1.8% | 6.0% | 4.7% | 5.0% |
| SF 1000-1500 | 5.9% | 11.0% | 12.6% | 15.7% | 11.3% | 12.5% | 8.9% |
| MF>1500 | 1.5% | 1.8% | 3.3% | 2.4% | 1.4% | 2.4% | 1.9% |
| SF>1500 | 9.5% | 29.1% | 32.0% | 61.3% | 76.1% | 38.6% | 22.9% |
| under 1500 SF | 16.8% | 18.9% | 26.0% | 20.7% | 17.4% | 21.6% | 19.0% |
| over 1500 SF | 11.0% | 30.9% | 35.3% | 63.7% | 77.6% | 41.0% | 24.8% |
| multifamily | 11.3% | 8.6% | 15.7% | 6.1% | 7.4% | 10.4% | 10.9% |
| single-family | 16.4% | 41.2% | 45.7% | 78.3% | 87.5% | 52.1% | 32.9% |
| no central air | 72.3% | 50.3% | 38.7% | 15.6% | 5.0% | 37.5% | 56.2% |
| <1000 sq ft mf | 22.6% | 6.0% | 2.2% | 0.9% | 0.2% | 3.5% | 13.8% |
| <1000 sq ft sf | 10.4% | 5.3% | 2.4% | 0.9% | 0.0% | 3.2% | 7.1% |
| 1000-1500 sq ft mf | 6.8% | 2.5% | 0.2% | 0.1% | 0.0% | 1.1% | 4.2% |
| 1000-1500 sq ft sf | 17.4% | 18.0% | 12.3% | 6.4% | 0.5% | 13.0% | 15.4% |
| > 1500 sq ft mf | 2.5% | 1.2% | 1.5% | 0.2% | 0.0% | 1.1% | 1.8% |
| > 1500 sq ft sf | 12.6% | 17.3% | 20.0% | 7.2% | 4.4% | 15.6% | 14.0% |
| under 1500 SF | 15.2% | 18.1% | 23.5% | 20.6% | 11.2% | 20.1% | 17.5% |
| over 1500 SF | 8.5% | 22.5% | 33.7% | 58.7% | 77.1% | 35.9% | 21.1% |
| multifamily | 31.9% | 9.7% | 3.9% | 1.2% | 0.2% | 5.7% | 19.8% |
| single-family | 40.4% | 40.5% | 34.7% | 14.4% | 4.8% | 31.8% | 36.4% |

Over 60% of the central air conditioners found among small users are in dwellings under 1500 square feet (that require less space conditioning per square foot) and 40% are in multi-family dwellings (that also require less space conditioning because of common walls with other dwellings). By comparison among customers who use more than 425 kWh, only 35% of their central air conditioners are in dwellings under 1500 square feet and only 16% are in multifamily dwellings.

⁵ There are slight differences in percentages reported in different tables because the tables include slightly different samples. For example, the table showing the relationship of central air conditioning by size and type of dwelling unit contained only those customers with valid data on both square footage and type of air conditioning. The more general table above on type of air conditioning did not exclude customers without valid square footage data and therefore has a slightly different result.

Data on central air conditioning saturation by climate zone is given below. It shows that small customers are less likely to have central air in the coastal areas and are more likely to have central air but live in small dwellings in interior zones. In all zones, the increased saturation of central air conditioning and the presence of central air in a large dwelling are the hallmark of larger customers,

Table 20: Air Conditioner Saturation and Size and Type of Dwelling by Summer Tier, Edison Cool Climate Zone Customers

| <u>Approximate rate tier</u> | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over | Average |
|------------------------------|----------|----------|----------|----------|------------|---------|---------|
| | <130% BL | 3rd Tier | 4th Tier | 5th Tier | Very large | 130% BL | |
| central air | 20.3% | 32.1% | 43.2% | 65.1% | 93.2% | 42.8% | 30.5% |
| under 1500 SF | 12.4% | 8.7% | 14.8% | 9.5% | 2.6% | 11.0% | 11.6% |
| over 1500 SF | 7.8% | 23.5% | 28.4% | 55.6% | 90.6% | 31.8% | 18.9% |
| multifamily | 12.0% | 6.7% | 13.0% | 2.8% | 1.1% | 8.4% | 10.2% |
| single-family | 8.2% | 25.5% | 30.2% | 62.3% | 92.1% | 34.4% | 20.3% |
| no central air | 79.7% | 67.9% | 56.8% | 34.9% | 6.8% | 57.2% | 68.3% |
| under 1500 SF | 62.8% | 40.8% | 21.7% | 17.9% | 0.0% | 29.0% | 46.4% |
| over 1500 SF | 16.9% | 27.1% | 35.1% | 17.0% | 6.8% | 28.2% | 22.0% |
| multifamily | 36.8% | 14.6% | 5.6% | 4.0% | 0.0% | 9.2% | 23.5% |
| single-family | 42.9% | 53.3% | 51.3% | 30.9% | 6.8% | 48.0% | 44.8% |

Table 21: Air Conditioner Saturation and Size and Type of Dwelling by Summer Tier, Edison Mid-Climature Zone Customers

| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 425 | Average |
|----------------|-------|---------|---------|----------|-------|----------|---------|
| | | | | | | kWh | |
| central air | 32.5% | 62.6% | 72.3% | 94.1% | 96.1% | 75.3% | 55.8% |
| under 1500 SF | 18.6% | 22.2% | 28.0% | 13.4% | 15.1% | 21.9% | 19.8% |
| over 1500 SF | 13.9% | 40.4% | 44.3% | 80.6% | 81.0% | 53.4% | 36.0% |
| multifamily | 11.1% | 10.3% | 12.9% | 10.8% | 2.7% | 10.9% | 10.6% |
| single-family | 21.4% | 52.3% | 59.4% | 83.2% | 93.4% | 64.4% | 45.2% |
| no central air | 67.5% | 37.4% | 27.7% | 5.9% | 3.9% | 24.7% | 40.6% |
| under 1500 SF | 54.7% | 19.2% | 14.3% | 1.2% | 0.0% | 12.2% | 28.4% |
| over 1500 SF | 12.8% | 18.2% | 13.4% | 4.8% | 3.9% | 12.6% | 12.2% |
| multifamily | 28.8% | 3.9% | 3.3% | 0.6% | 0.0% | 2.7% | 12.8% |
| single-family | 38.7% | 33.5% | 24.4% | 5.4% | 3.9% | 22.1% | 27.8% |

Table 22: Air Conditioner Saturation and Size and Type of Dwelling by Summer Tier, Edison Hot Climate Zone Customers

| <u>Approximate rate tier</u> | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over | Average |
|------------------------------|----------|----------|----------|----------|------------|---------|---------|
| | <130% BL | 3rd Tier | 4th Tier | 5th Tier | Very large | 130% BL | |
| central air | 50.5% | 68.1% | 79.2% | 91.9% | 97.0% | 82.4% | 70.7% |
| under 1500 SF | 31.3% | 32.1% | 37.5% | 26.6% | 14.8% | 30.2% | 28.4% |
| over 1500 SF | 19.2% | 36.0% | 41.8% | 65.3% | 82.2% | 52.2% | 42.3% |
| multifamily | 8.1% | 8.5% | 18.4% | 3.8% | 1.5% | 9.2% | 8.3% |
| single-family | 42.5% | 59.6% | 60.8% | 88.1% | 95.5% | 73.2% | 62.4% |
| no central air | 49.5% | 31.9% | 20.8% | 8.1% | 3.0% | 17.6% | 22.7% |
| under 1500 SF | 38.0% | 27.5% | 11.8% | 5.5% | 0.3% | 12.6% | 16.8% |
| over 1500 SF | 11.5% | 4.4% | 9.0% | 2.6% | 2.7% | 5.0% | 5.9% |
| multifamily | 16.3% | 6.5% | 0.5% | 0.0% | 0.3% | 1.9% | 4.6% |
| single-family | 33.1% | 25.5% | 20.3% | 8.1% | 2.7% | 15.8% | 18.2% |

In sum, demand response potential is considerably smaller among small customers (using less than 425 kWh), not just because they are small users, but because their use is less weather-sensitive than average. Their average energy use per month is 271 kWh. Their annual load patterns are flat (with only 17% using 30% more in the summer than in shoulder months). Over 60% have no air conditioning at all; and, among the 28% with central air conditioning, disproportionate numbers of small customers live in smaller dwellings and multifamily dwellings that use less energy.

Finally, we look at income and household size to look at distributional equity issues. Usage increases dramatically as income rises, as shown in the next two charts.

Table 23: Income Characteristics of Customers in Each Summer Tier, Edison Customers

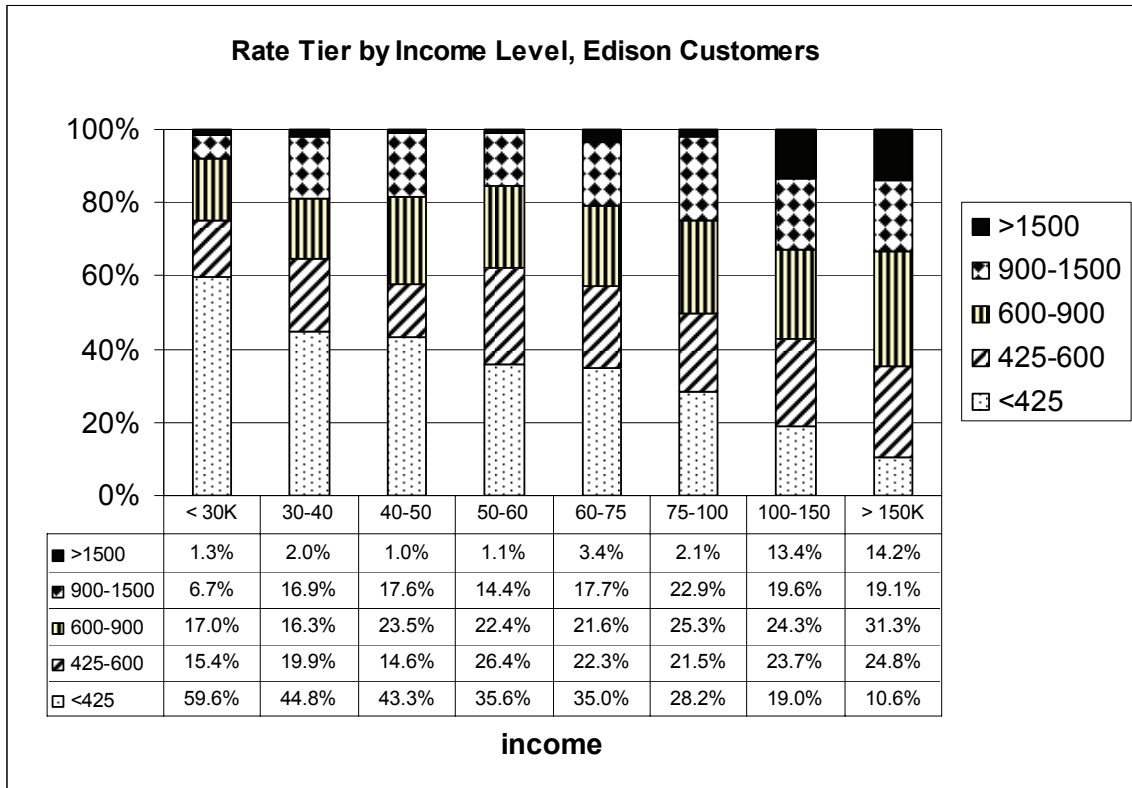
| <u>Approximate rate tier</u> | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | 900-1500 5th Tier | >1500 Very large | Over 130% BL | Average |
|------------------------------|------------------|---------------------|---------------------|----------------------|---------------------|-----------------|---------|
| < 30K | 46.2% | 24.6% | 25.6% | 14.5% | 11.6% | 21.2% | 31.1% |
| 30-40 | 14.2% | 13.0% | 10.1% | 15.0% | 7.2% | 12.3% | 13.1% |
| 40-50 | 8.6% | 6.0% | 9.1% | 9.8% | 2.2% | 7.9% | 8.2% |
| 50-60 | 8.6% | 13.1% | 10.5% | 9.7% | 3.0% | 10.7% | 9.8% |
| 60-75 | 8.8% | 11.6% | 10.6% | 12.5% | 9.5% | 11.4% | 10.4% |
| 75-100 | 7.6% | 11.9% | 13.2% | 17.2% | 6.2% | 13.6% | 11.2% |
| 100-150 | 4.2% | 10.8% | 10.4% | 12.1% | 32.9% | 12.3% | 9.1% |
| > 150 K | 1.8% | 8.9% | 10.6% | 9.3% | 27.5% | 10.6% | 7.2% |
| average income (\$'000) | 42.2 | 66.2 | 68.1 | 72.7 | 108.8 | 71.2 | 59.7 |

The average income of customers using less than 425 kWh is \$42,200, compared to \$71,200 for those using more than 425 kWh and \$108,800 for users of more than 1500 kWh per month.

Over 60% of small users have an income of less than \$40,000, compared to 33.5% of those using more 425 kWh and about 24% of those above 900 kWh.

Conversely, 6% of small users have an income over \$100,000, compared to 19% of those using more than 425 kWh, 21% of users of 600-1500 kWh, and 60% of those using over 1500 kWh per month..

Figure 2: Percentage of Customers in Each Tier by Income, SCE



Among those with less than \$30,000 of income, almost 60% use less than 425 kWh. 44% of customers from \$30,000 to \$50,000, 35% of customers from \$50,000 to \$75,000 are small customers. This compares to about 28% of those between \$75,000 and \$100,000 and about 19% of those earning from \$100,000 to \$150,000 and 11% of those earning over \$150,000. The percentage of customers reaching 900 kWh goes from 1.3% among those earning less than \$30,000 to 27% of those earning over \$150,000.

There are regional differences. The table below summarizes the average income of users of various amounts by climate area.

Table 24: Average Income versus Usage (kwh per summer month), Edison System and Climate Areas

| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 130% BL | Average |
|---------------------|------|---------|---------|----------|-------|-----------------|---------|
| whole Edison system | 42.2 | 66.2 | 68.1 | 72.7 | 108.8 | 71.2 | 59.7 |
| cool climate zone | 45.8 | 76.9 | 83.0 | 89.8 | 142.8 | 82.8 | 62.5 |
| mid climate zone | 40.0 | 67.3 | 65.2 | 88.2 | 116.6 | 74.3 | 58.2 |
| hot climate zone | 29.1 | 47.2 | 51.5 | 63.7 | 105.2 | 59.5 | 49.6 |

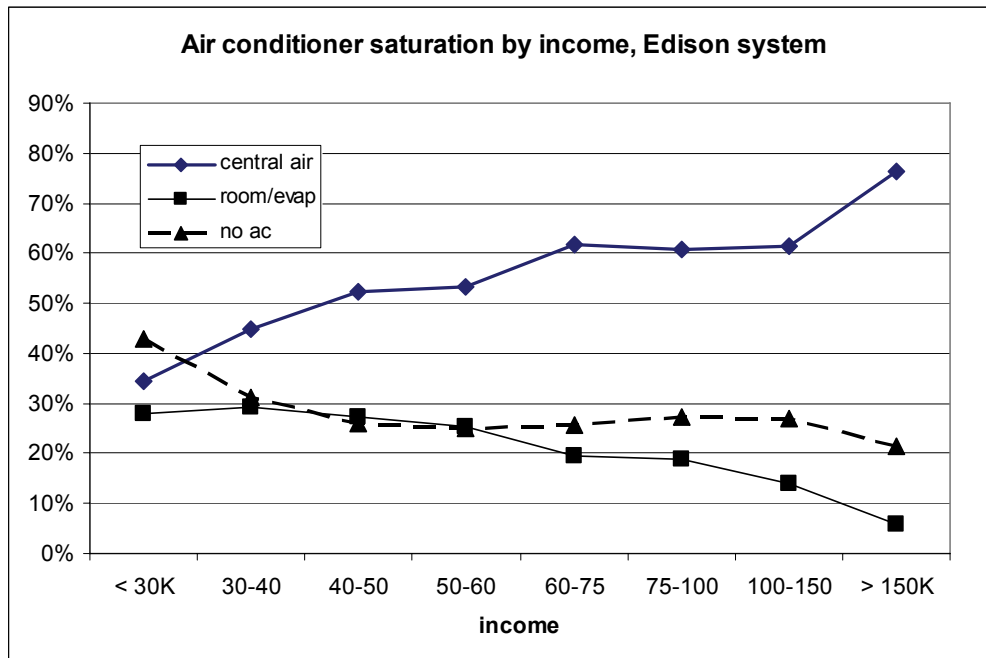
There are fewer very large users in the cool climate zone, but the large users that are present are more likely to be rich.

In the coastal zone, 39% of customers using over 900 kWh (approximately the beginning of the fifth tier in that zone) earn more than \$100,000, and 79% of users of 1500 kWh or more have similar earnings. By comparison, 55% of users of less than 425 kWh earn less than \$40,000.

The hot zone is marked with both a lower average income and higher consumption (as well as higher baseline allowances) than elsewhere on the Edison system. The relatively few small users have very low incomes in this region, and large users are not as wealthy, because of the harsh climate. Even so, users of more than 1500 kWh per month have an average income above \$100,000, like the rest of the Edison system.

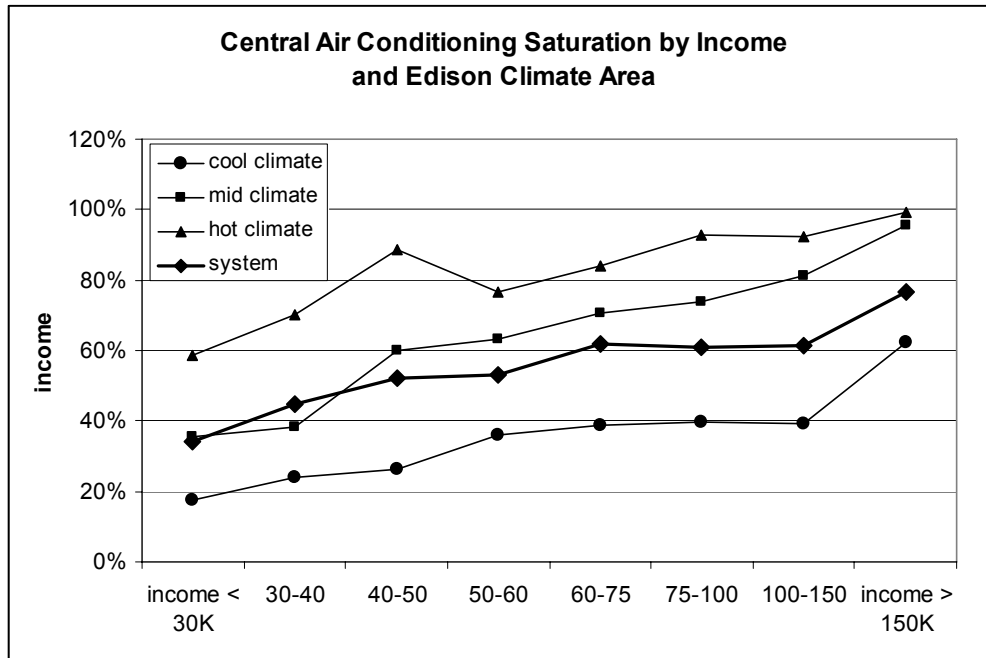
Part of the reason for both the differences in consumption by income is that central air conditioner saturation rises rapidly with income – from 34% of those with less than \$30,000 to 76% of those with more than \$150,000.

Figure 3: Air Conditioner Saturation by Income



Air conditioner saturation is a function of both income and location. As can be expected, the hotter zones have higher saturations of central air conditioning, although the prevalence of central air conditioning increases in all areas as income rises. One of the differences is that lower income people in the hot zone are more likely to use evaporative coolers or room air conditioners, while more in the cooler and mid zones have no air conditioning.

Figure 4: Central Air Conditioner Saturation by Income and Edison Climate Area



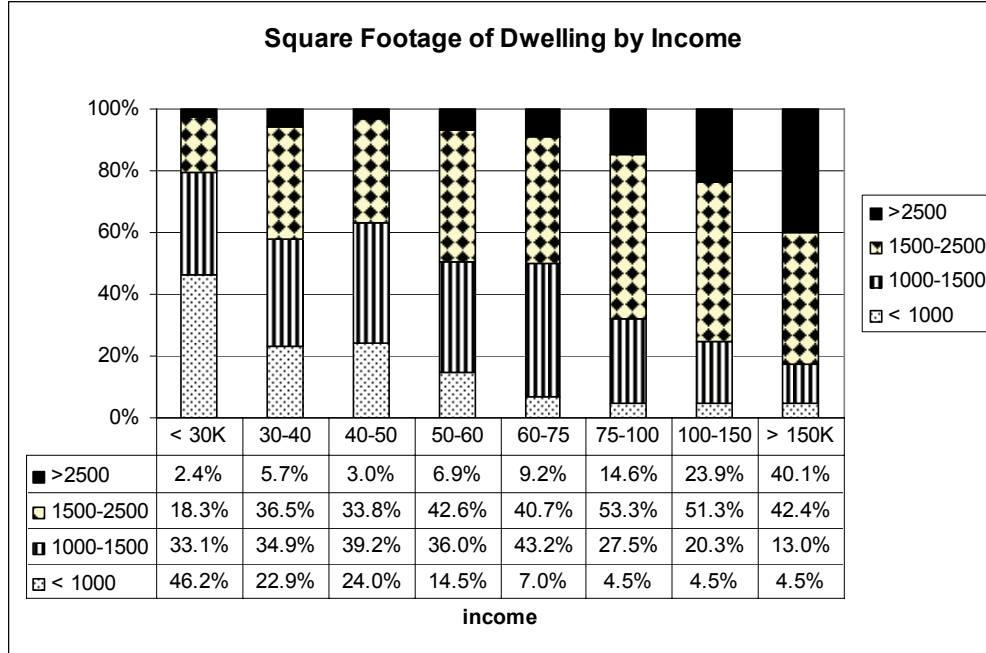
In addition, as can be expected, more well-to-do households own a higher percentage of larger dwellings and a higher percentage of single-family dwellings, thus using more energy.

Table 25: Percentage of Multifamily Customers by Income

| | % multifamily |
|---------|---------------|
| < 30K | 42.3% |
| 30-40 | 29.5% |
| 40-50 | 29.9% |
| 50-60 | 20.6% |
| 60-75 | 24.2% |
| 75-100 | 17.1% |
| 100-150 | 12.0% |
| > 150 K | 17.2% |

Multifamily dwellers fall from 42% of households below \$30,000 to about 15% above \$100,000.

Figure 5: Square Footage of Dwelling by Income, Edison system



The size of dwelling also increases with income – 46% of those with less than \$30,000 of income live in a space of less than 1000 square feet, while 40% of those making more than \$150,000 dwell in more than 2500 square feet.

Usage also generally increases with household size.

Table 26: Percentage of Customers by Usage and by Household Size, Edison system

| | summer average monthly use (kWh) | | | | | > 425 | Average |
|---------------------|----------------------------------|---------|---------|----------|-------|-------|---------|
| | <425 | 425-600 | 600-900 | 900-1500 | >1500 | | |
| Household 1 | 27.6% | 12.0% | 9.1% | 10.7% | 2.1% | 10.1% | 17.0% |
| Household 2 | 27.4% | 30.9% | 31.5% | 33.4% | 27.5% | 31.6% | 30.0% |
| Household 3 | 15.2% | 20.7% | 16.2% | 16.3% | 16.6% | 17.7% | 16.7% |
| Household 4 | 13.7% | 15.6% | 19.9% | 20.1% | 22.0% | 18.7% | 16.7% |
| Household 5 or more | 16.1% | 20.8% | 23.3% | 19.5% | 31.9% | 21.9% | 19.6% |

28% of small users are single-person households, compared to 10% of those using more than 425 kWh, while there are fewer large households among small users. Almost 32% of those using 1500 kWh per month are five person households.

However, a significant portion of the reason why usage increases with household size arises because electricity use among the wealthiest of Edison’s customers rises dramatically as family size increases, particularly in the mid and hot climate zones. Increases in family size are associated with only relatively modest impacts on usage below \$100,000 in income and in the cool climate zone. The inclusion of interactive variables for large high-income families has strong explanatory power in the two warmer climate zones, as shown below.

Table 27: Average Monthly Summer Month Use by Income and Household Size

| | <u><50K</u> | <u>50-100K</u> | <u>> \$100K</u> | <u>All</u> |
|----------------------------|----------------|----------------|--------------------|------------|
| <u>hot climate</u> | | | | |
| 1 | 542 | 902 | 1,341 | 602 |
| 2 | 746 | 820 | 1,074 | 799 |
| 3 | 665 | 928 | 1,227 | 816 |
| 4 | 701 | 735 | 1,223 | 848 |
| 5+ | 722 | 875 | 1,798 | 906 |
| 2 > 1 | 204 | (82) | (266) | 197 |
| 5 > 2 | (23) | 55 | 724 | 107 |
| <u>mid climate</u> | | | | |
| 1 | 348 | 483 | 577 | 363 |
| 2 | 491 | 572 | 721 | 562 |
| 3 | 439 | 762 | 1,017 | 648 |
| 4 | 561 | 763 | 879 | 681 |
| 5+ | 635 | 708 | 1,347 | 716 |
| 2 > 1 | 143 | 89 | 144 | 199 |
| 5 > 2 | 144 | 136 | 626 | 153 |
| <u>cool climate</u> | | | | |
| 1 | 328 | 301 | 377 | 324 |
| 2 | 431 | 472 | 665 | 496 |
| 3 | 369 | 459 | 602 | 456 |
| 4 | 362 | 533 | 746 | 498 |
| 5+ | 459 | 636 | 844 | 567 |
| 2 > 1 | 104 | 171 | 288 | 173 |
| 5 > 2 | 28 | 164 | 179 | 71 |

D. Findings and Conclusions

While the Edison system has variations due to climate zones, the RASS data support and explain the conclusions from Edison’s load research data that indicate that small customers already have better load patterns than the system average and have limited demand response potential.

1. They use considerably less energy to start with – 271 kWh per month, compared to 1,267 kWh per month among those using more than 900 kWh per month and 847 kWh per month among all customers using more than 425 kWh per month.
2. Only 17% of them have a peaked load pattern (more than 30% more use in the peak summer months than in shoulder months), compared to 56% of those using more than 425 kWh per month.
3. They live in dwellings that use less energy, particularly for heating and cooling. 47% are in multifamily units (compared to 16% of those above 425 kWh) and 38% live in dwellings of less than 1000 square feet.
4. About 50% of them have no air conditioning at all.
5. Of the 28% who do have central air conditioning (vs. 62% above 425 kWh) only 40% live in dwellings bigger than 1500 square feet (compared to 65% of those with central air who use more than 425 kWh)

Those using less than 425 kWh per month have a household income averaging \$42,200 in 2002. Those using over 425 kWh per month had an average income that was 69% higher at \$71,200. Over 60% of those using less 425 kWh per month had an income of less than \$40,000, compared to 33% of those using over 130% of baseline. These income differentials among electric users of varying sizes are largely explained by the same factors that make small customers poor candidates for demand response – a larger percentage of multifamily dwellers, smaller sized housing units, fewer discretionary appliances, and a lower saturation of central air conditioning as income declines.

III.SDG&E

A. Analysis of SDG&E Load Research Data

Load research information provided by SDG&E for the year 2006 demonstrates the percentage of summer on-peak energy use increases and the load factor decreases as usage goes up.

We calculated a series of statistics (weighted by the number of customers) for customers in four different size groups (based on summer kWh consumption) that approximately correspond to those customers who stay under 130% of baseline (1700 kWh per summer) and those in the third tier (1700-2400 kWh), fourth tier (2400-3600 kWh), and fifth tier (over 3600 kWh in the four summer months). The tables below also include the group of “Very large” residential customers, consuming over 6000 kWh in the 4 summer months (greater than 1500 kWh per month). In the discussion that follows the term “small customers” generally refers to the group using under 130% of baseline.

Our analysis excluded customers on voluntary time of use rates and customers with incomplete data records (less than 115 of 122 summer days and less than 220 of 243 winter days)⁶, and (for those with less than the total number of summer or winter days) data were adjusted to reflect a full number of summer and winter days. We also excluded customers with usage of less than 200 kWh in the total of the four summer months (50 kWh per month) as invalid data or atypical customers.

The three tables below summarize our analysis for basic customers, all-electric customers, and all SDG&E residential customers.

⁶ More winter days were allowed to be incomplete because the main focus of the analysis was on the summer months.

**Table 28: 2006 Load Research Data by Size of Customer.
All SDG&E Residential Customers**

| <u>Approximate Rate Tier</u> | Average summer month use (kWh) | | | | | >130% BL | All customers |
|---------------------------------------|--------------------------------|---------------------|---------------------|------------------|---------------------|----------|---------------|
| | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | >900 5th Tier | >1500 very large | | |
| TOTAL | | | | | | | |
| Avg summer ,monthly on-peak kWh | 66 | 112 | 178 | 332 | 596 | 170 | 134 |
| Avg summer monthly kWh | 304 | 508 | 750 | 1,291 | 2,182 | 720 | 574 |
| Summer on-peak % | 21.6% | 22.0% | 23.7% | 25.7% | 27.3% | 23.7% | 23.3% |
| Avg winter monthly use | 358 | 461 | 593 | 841 | 1,330 | 569 | 495 |
| Avg hourly summer use (kW) | 0.42 | 0.69 | 1.03 | 1.76 | 2.98 | 0.98 | 0.78 |
| Avg hourly annual use (kW) | 0.47 | 0.65 | 0.88 | 1.36 | 2.21 | 0.85 | 0.71 |
| July (heatstorm) coincident peak (kW) | 0.64 | 1.39 | 2.38 | 3.30 | 6.17 | 2.07 | 1.57 |
| Avg 4 summer month CP (kW) | 0.58 | 1.15 | 1.97 | 3.29 | 5.74 | 1.80 | 1.37 |
| Summer ratio * | 108% | 125% | 188% | 200% | 228% | 161% | 143% |
| % peaked customers * | 16% | 27% | 55% | 68% | 81% | 44% | 34% |
| Annual load factor (July peak) | 72% | 47% | 37% | 41% | 36% | 41% | 46% |
| Annual load factor (summer avg peak) | 80% | 57% | 45% | 41% | 39% | 47% | 52% |
| Summer load factor (July peak) | 64% | 50% | 43% | 53% | 48% | 48% | 50% |
| Summer load factor (summer avg peak) | 71% | 60% | 52% | 54% | 52% | 55% | 57% |

* Summer ratio is defined as Avg. summer load as % of March and April
 ** Peaked customer is defined as customer with summer ratio > 130%

**Table 29: 2006 Load Research Data by Size of Customer.
SDG&E Basic Residential Customers**

| <u>Approximate Rate Tier</u> | Average summer month use (kWh) | | | | | >130% BL | All customers |
|--------------------------------------|--------------------------------|---------------------|---------------------|------------------|---------------------|----------|---------------|
| | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | >900 5th Tier | >1500 very large | | |
| BASIC | | | | | | | |
| Avg summer ,monthly on-peak kWh | 68 | 108 | 175 | 317 | 602 | 166 | 131 |
| Avg summer monthly kWh | 314 | 510 | 749 | 1,261 | 2,246 | 719 | 575 |
| Summer on-peak % | 21.5% | 21.1% | 23.4% | 25.2% | 26.8% | 23.1% | 22.8% |
| Avg winter monthly use | 332 | 461 | 588 | 829 | 1,448 | 568 | 484 |
| Avg hourly summer use (kW) | 0.43 | 0.70 | 1.02 | 1.72 | 3.07 | 0.98 | 0.79 |
| Avg hourly annual use (kW) | 0.45 | 0.65 | 0.88 | 1.33 | 2.35 | 0.85 | 0.70 |
| July coincident peak (kW) | 0.63 | 1.38 | 2.26 | 3.02 | 6.15 | 1.99 | 1.51 |
| Avg 4 summer month CP (kW) | 0.59 | 1.15 | 1.89 | 3.23 | 6.28 | 1.76 | 1.35 |
| Summer ratio * | 120% | 121% | 197% | 209% | 234% | 167% | 150% |
| % peaked customers * | 21% | 25% | 51% | 67% | 75% | 43% | 35% |
| Annual load factor (July peak) | 70% | 48% | 39% | 44% | 38% | 42% | 47% |
| Annual load factor (summer avg peak) | 75% | 57% | 47% | 41% | 37% | 48% | 52% |
| Summer load factor (July peak) | 68% | 51% | 45% | 57% | 50% | 49% | 52% |
| Summer load factor (summer avg peak) | 72% | 61% | 54% | 53% | 49% | 56% | 58% |

* Summer ratio is defined as Avg. summer load as % of March and April
 ** Peaked customer is defined as customer with summer ratio > 130%

**Table 30: 2006 Load Research Data by Size of Customer.
SDG&E All-Electric Residential Customers**

| <u>Approximate Rate Tier</u> | Average summer month use (kWh) | | | | | >130% BL | All customers |
|--------------------------------------|--------------------------------|---------------------|---------------------|------------------|---------------------|----------|---------------|
| | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | >900 5th Tier | >1500 very large | | |
| ALL-ELECTRIC | | | | | | | |
| Avg summer ,monthly on-peak kWh | 60 | 76 | 188 | 369 | 588 | 114 | 101 |
| Avg summer monthly kWh | 274 | 329 | 757 | 1,370 | 2,103 | 468 | 422 |
| Summer on-peak % | 22.0% | 23.2% | 24.9% | 26.9% | 27.9% | 24.4% | 24.0% |
| Avg winter monthly use | 442 | 309 | 612 | 871 | 2,362 | 396 | 407 |
| Avg hourly summer use (kW) | 0.37 | 0.45 | 1.03 | 1.87 | 2.87 | 0.64 | 0.58 |
| Avg hourly annual use (kW) | 0.53 | 0.43 | 0.90 | 1.42 | 3.12 | 0.58 | 0.56 |
| July coincident peak (kW) | 0.68 | 0.78 | 2.88 | 4.03 | 6.18 | 1.34 | 1.19 |
| Avg 4 summer month CP (kW) | 0.55 | 0.68 | 2.37 | 3.43 | 5.32 | 1.14 | 1.00 |
| Summer ratio * | 69% | 144% | 145% | 177% | 220% | 146% | 128% |
| % peaked customers * | 0% | 37% | 70% | 72% | 89% | 45% | 34% |
| Annual load factor (July peak) | 78% | 55% | 31% | 35% | 50% | 43% | 48% |
| Annual load factor (summer avg peak) | 97% | 64% | 38% | 41% | 59% | 51% | 56% |
| Summer load factor (July peak) | 55% | 58% | 36% | 46% | 46% | 48% | 49% |
| Summer load factor (summer avg peak) | 68% | 66% | 44% | 55% | 54% | 56% | 58% |

The results are consistent with our findings in two previous analyses of SDG&E⁷ that show that SDG&E’s small customers use considerably less peak period energy than its large customers, both in total and in proportion.

SDG&E’s customers who use more than 1500 kWh per month in the months of June-September use 7.17 times as much energy in those months as customers who have use below 130% of baseline.⁸ However, they use 9 times as much peak period energy (27.3% of summer use on-peak vs. 21.6% for those under 130% of baseline), and 9.55 to 9.85 times as much coincident peak demand (depending on whether demand is measured using the extraordinarily high July heatstorm peak or the average of the four summer peaks). These “very large” customers also use only 3.71 times as much energy as the other customers in the eight non-summer months. As a result, the annual coincident peak load

⁷ W. Marcus, Prepared Testimony on behalf of Utility Consumers’ Action Network in App. 07-01-041 (SDG&E GRC Phase 2), August, 2007, p. 38. W. Marcus, Prepared Testimony on behalf of Utility Consumers’ Action Network in App. 91-11-024 (SDG&E 1999 Rate Design Window Phase), March, 2000, pp. 40-41. The second source was edited and republished in W. Marcus, G. Ruzsovan, and J. Nahigian, “Economic and Demographic Factors Affecting California Residential Energy Use,” September, 2002. Available at <http://www.jbsenergy.com>.

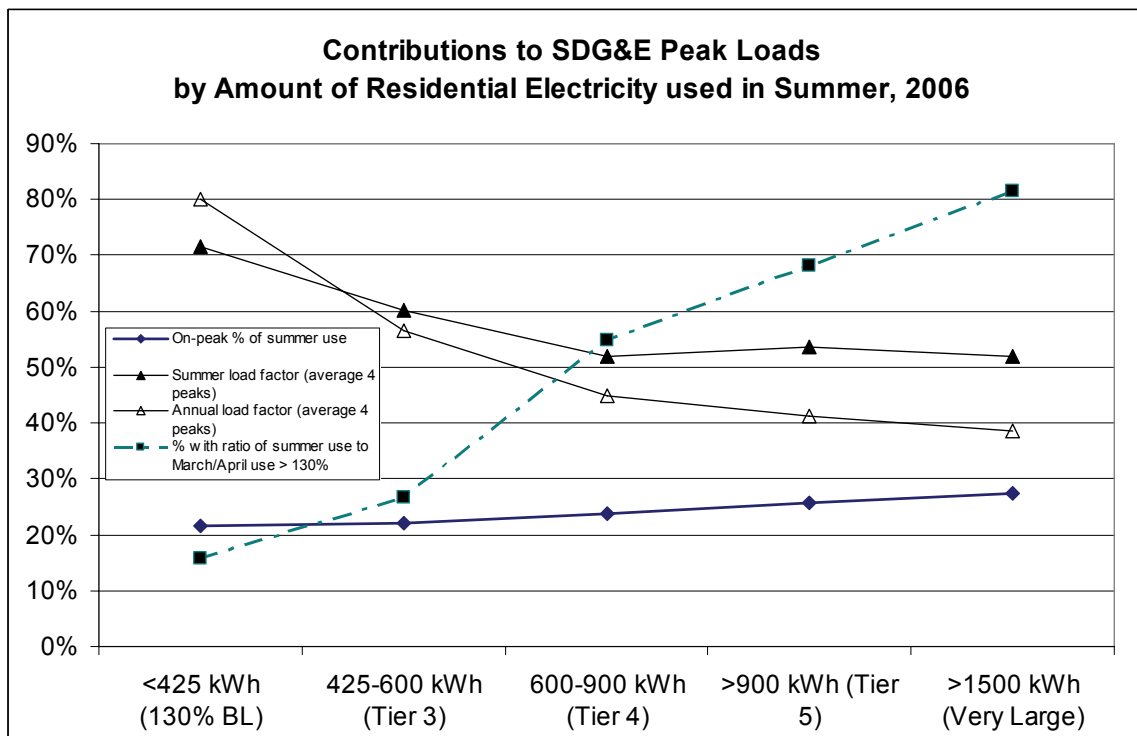
⁸ While SDG&E did not provide a large amount of end-use data with its load research sample, we were able to determine that over 23% of the customers over 1500 kWh have swimming pools.

factors⁹ are twice as high for customers under 130% of baseline as for customers over 1500 kWh per month in June-September (72% vs. 36% using the unusual July peak as a benchmark and 80% versus 39% using the average of the four summer coincident peaks).

Another statistic that shows the extent to which large summer users are responsible for peak energy is the ratio of summer monthly energy to monthly energy in the shoulder months of March and April. PG&E uses a ratio of 130% as a rule of thumb to determine whether a customer has an air conditioner that is used extensively. Only 16% of customers using less than 130% of baseline had a summer ratio above 130%, compared to 27% of third tier users, 55% of fourth tier users, 68% of fifth tier users, and 81% of those over 1500 kWh per summer month.

The figure below provides summary statistics from the table above, showing the increasing percentage of summer peak use, the declining summer and annual load factors, and the increasing number of customers whose summer use is far higher than their winter use as summer usage increases.

Figure 6: Relationships of SDG&E Peak Load Impacts to Summer Energy Use



⁹ A low load factor denotes a more peaked load; a high load factor is closer to baseload.

B. Analysis of SDG&E RASS Data

SDG&E also provided data from its Residential Appliance Saturation Survey (RASS) matched to billing data. The data were from 2002, unlike the later load research data. However, the RASS data and the load research data reach the same conclusions – that small customers’ contributions to demand response will be minimal.¹⁰

The RASS data explain why the load research results show what they show - considerably less peak period energy use among small summer energy users than among larger users.

The RASS data were collected in 2002-2003. Data were first screened to remove (1) seasonally occupied dwellings; (2) customers without complete kWh sales data for 2002; and (3) customers using less than 50 kWh per month in any of the six months of June-September and March-April, 2002¹¹(to remove very unusual customers or poor data).

We focused on use in the four peak summer months of June-September because this is the time frame when critical peak pricing programs would be operative.

The RASS sample showed the following information on customer usage in June-September versus the remainder of the year.

Table 31: Customers, Use, and Peaked Seasonal Use by Summer Tier, SDG&E
Average monthly summer use (kWh)

| | <425 | 425-600 | 600-900 | >900 | >1500 | Over 425 kWh | Average |
|------------------------------|----------|----------|----------|----------|------------|-----------------|---------|
| <u>Approximate rate tier</u> | <130% BL | 3rd Tier | 4th Tier | 5th Tier | Very large | | |
| % of customers | 53.8% | 19.5% | 15.5% | 8.9% | 2.2% | | |
| average kWh summer month | 257 | 501 | 728 | 1,111 | 2,354 | 784 | 501 |
| avg kWh non-summer month | 286 | 518 | 761 | 1,100 | 2,133 | 790 | 519 |
| % peaked * | 7.6% | 7.0% | 15.6% | 15.3% | 43.5% | 13.3% | 10.2% |

Customers using less than the AB-1X limits were numerous (almost 54% of the customers), but they used only 51% of the system average summer energy use and 33% as much summer energy as customers over 130% of baseline. The sample indicated that

¹⁰ The RASS study and the load research study were drawn on different samples of customers at different times. Therefore, usage figures for each size block of customers cannot be expected to be identical in the two studies.

¹¹ March April data were used only to compute the summer ratio, described below.

they accounted for 28% of the energy used by SDG&E customers, with 72% of the energy used by the 46% of customers who exceeded 130% of baseline.

Customers using less than 130% of baseline in the peak summer months also had flat annual load patterns; only 7% had load patterns reflecting significant air conditioning load (30+% more in July-September than in the shoulder months of March and April, using PG&E’s proxy definition). SDG&E’s overall load patterns were flat, with only 13% of customers using more than 130% of baseline indicating “significant air conditioning load,” but small customers still were less peaked than the average. Moreover, 15% of smaller tier 5 customers and 44% of very large of Tier 5 customers had load patterns with a pronounced increase in the summer months, demonstrating higher AC loads associated with higher usage.

The reason for lower usage and flatter usage patterns becomes obvious from appliance saturation and housing size data. We start with housing characteristic and square footage data.

Table 32: Type of Dwelling and Ownership by Baseline Tier, SDG&E

| <u>Approximate rate tier</u> | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 425 | Average |
|------------------------------|----------|----------|----------|----------|------------|----------|---------|
| | <130% BL | 3rd Tier | 4th Tier | 5th Tier | Very large | kWh | |
| single family | 49.0% | 82.1% | 91.0% | 96.7% | 100.0% | 88.8% | 67.4% |
| multifamily | 48.8% | 17.5% | 8.5% | 1.5% | 0.0% | 10.6% | 31.1% |
| mobile home * | 2.2% | 0.4% | 0.5% | 0.9% | 0.0% | 0.5% | 1.4% |
| rent | 40.2% | 13.0% | 2.2% | 1.3% | 0.0% | 6.5% | 24.6% |
| own | 59.8% | 87.0% | 97.8% | 98.7% | 100.0% | 93.5% | 75.4% |
| rent MF | 34.5% | 6.0% | 1.2% | 0.8% | 0.0% | 3.1% | 20.0% |
| own MF | 16.4% | 12.4% | 6.4% | 1.3% | 0.0% | 7.6% | 12.3% |
| rent SF | 5.7% | 6.9% | 1.0% | 0.5% | 0.0% | 3.4% | 4.6% |
| own SF | 43.4% | 74.6% | 91.5% | 97.5% | 100.0% | 85.9% | 63.0% |

* in the remainder of this analysis, mobile homes are included with single family because their energy use characteristics are similar to single family.

Far more small customers live in multifamily housing than large customers – 48.8% are apartment dwellers vs. 10.6% of those using more than 130% of baseline. While 51% of small customers live in single-family homes (including mobile homes), this is far less than the 89% of customers in single-family homes among those using more than 130% of baseline (including over 97% of Tier 5 customers).

In addition, far more small customers are renters – which means that they would find it difficult to make investments to save energy (e.g., better appliances) in response to pricing programs.

The square footage results are given below and further summarized by dwelling type.

Table 33: Square Footage and Type of Dwelling by Baseline Tier

| <u>Approximate rate tier</u> | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over 425 | Average |
|------------------------------|----------|----------|----------|----------|------------|----------|---------|
| | <130% BL | 3rd Tier | 4th Tier | 5th Tier | Very large | kWh | |
| <500 sf | 3.7% | 0.7% | 0.0% | 0.0% | 0.0% | 0.3% | 2.1% |
| 500-750 | 11.8% | 1.0% | 0.2% | 0.0% | 0.0% | 0.5% | 6.6% |
| 750-1000 | 22.8% | 6.1% | 1.2% | 0.7% | 0.0% | 3.1% | 13.7% |
| 1000-1250 | 16.2% | 16.2% | 5.0% | 2.1% | 0.0% | 8.9% | 12.8% |
| 1250-1500 | 16.4% | 21.7% | 10.0% | 2.7% | 3.7% | 13.2% | 14.9% |
| 1500-2000 | 18.4% | 27.8% | 28.3% | 19.6% | 3.2% | 25.2% | 21.5% |
| 2000-2500 | 8.0% | 12.4% | 22.4% | 7.9% | 26.3% | 15.5% | 11.5% |
| 2500-3000 | 1.6% | 12.3% | 16.0% | 27.1% | 11.1% | 16.4% | 8.4% |
| 3000-4000 | 0.9% | 1.8% | 16.0% | 33.6% | 24.8% | 13.8% | 6.9% |
| > 4000 sf | 0.3% | 0.1% | 0.8% | 6.4% | 30.9% | 3.1% | 1.6% |
| avg square feet | 1,279 | 1,714 | 2,247 | 2,811 | 3,665 | 2,199 | 1,704 |
| <1000 sq ft mf | 28.4% | 5.8% | 0.9% | 0.0% | 0.0% | 2.8% | 16.5% |
| <1000 sq ft sf | 9.9% | 1.9% | 0.5% | 0.7% | 0.0% | 1.1% | 5.9% |
| 1000-1500 sq ft mf | 16.8% | 9.6% | 5.2% | 1.2% | 0.0% | 6.0% | 11.9% |
| 1000-1500 sq ft sf | 15.7% | 28.2% | 9.8% | 3.6% | 3.7% | 16.1% | 15.9% |
| > 1500 sq ft mf | 3.5% | 2.7% | 2.1% | 0.0% | 0.0% | 1.9% | 2.7% |
| > 1500 sq ft sf | 25.7% | 51.7% | 81.4% | 94.5% | 96.3% | 72.1% | 47.1% |

Over 38% of small customers live in dwellings under 1000 square feet, with an additional 32% in 1000-1500 square feet and only 29% over 1500 square feet, and 1% above 3000 square feet. By comparison, among customers using more than 130% of baseline, only 4% live in dwellings under 1000 square feet; 22% in 1000-1500 square feet, 73% above 1500 Square feet, and 17% over 3000 square feet. A much larger proportion of very large customers live in very large homes, with over 67% of customers whose bills reach Tier 5 living in more than 2500 square feet.

Next we turn to saturation of energy-consuming equipment that is particularly amenable to demand response.

Table 34: Air Conditioner, Swimming Pool, and Laundry Saturation by Summer Tier, SDG&E

| <u>Approximate rate tier</u> | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | 900-1500 5th Tier | >1500 Very large | Over 425 kWh | Average |
|------------------------------|------------------|---------------------|---------------------|----------------------|---------------------|-----------------|---------|
| central a/c | 29.2% | 33.7% | 49.3% | 58.7% | 97.4% | 46.9% | 37.3% |
| no a/c | 63.7% | 58.1% | 45.5% | 39.4% | 0.5% | 47.5% | 56.2% |
| room/evap a/c | 8.8% | 9.8% | 11.0% | 4.5% | 5.2% | 8.9% | 8.9% |
| pool | 2.4% | 9.0% | 33.2% | 63.9% | 84.1% | 31.4% | 15.8% |
| home laundry | 77.9% | 95.4% | 97.5% | 99.8% | 100.0% | 97.2% | 86.8% |
| electric stove | 8.5% | 16.8% | 10.0% | 17.9% | 23.6% | 15.1% | 11.5% |

Almost 64% of small customers do not have an air conditioner at all, compared to only 31% of fifth tier customers (but virtually none using over 1500 kWh/month). The percentage of central air conditioning rises as usage increases, from 29% of small customers to over 66% of Tier 5 customers. The percentage of swimming pools among small customers is a trivial 2%, compared to 31.4% among customers exceeding 130% of baseline and 84% of very large customers using 1500 kWh per month. While most customers have home laundry equipment, only 77.9% of small customers have it compared to 97% of customers using over 130% of baseline. Electric stoves (which contribute little to the “headline” peak load in mid-afternoon, but constitute significant portions of critical peak loads from 5:00 to 7:00 pm) are not prevalent on the SDG&E system (only 11.5% saturation) Nevertheless, small customers have fewer of them - 9%, compared to 15% of those using more than 130% of baseline. Thus the adages that customers can manage their peak demand by doing their laundry later or not cooking apply less to small customers than to larger customers because a disproportionate number of small customers do not have the equipment in their homes..

While 29% of small customers actually have central air conditioning (compared to 47% of customers using more than 130% of baseline and over 80% of Tier 5 customers), those small customers with central air conditioning also have much smaller dwellings than customers who end up above 130% of baseline.

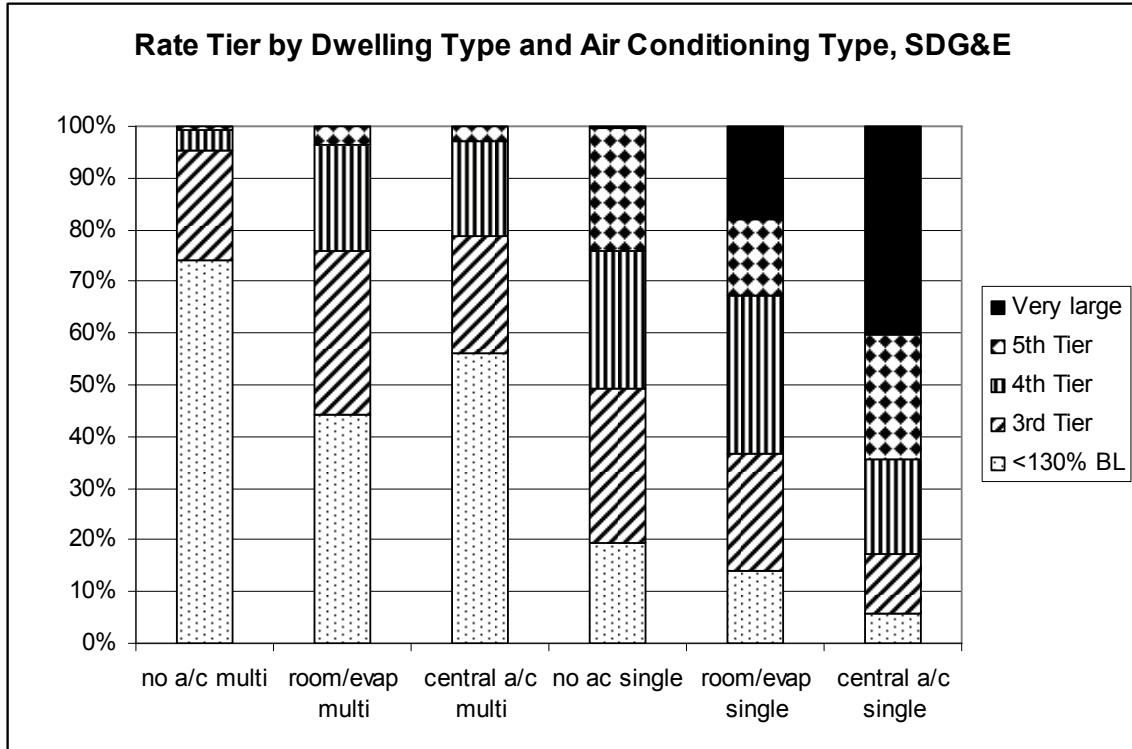
Table 35: Air Conditioner Saturation and Size and Type of Dwelling by Summer Tier

| Approximate rate tier | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over | Average |
|------------------------------|----------|----------|----------|----------|------------|---------|---------|
| | <130% BL | 3rd Tier | 4th Tier | 5th Tier | Very large | 130% BL | |
| central air | 28.7% | 34.7% | 47.1% | 58.6% | 97.4% | 46.5% | 36.9% |
| MF under 1000 sf | 7.2% | 2.5% | 0.3% | 0.0% | 0.0% | 1.2% | 4.4% |
| SF under 1000 sf | 0.4% | 0.5% | 0.0% | 0.6% | 0.0% | 0.3% | 0.4% |
| MF 1000-1500 | 6.0% | 2.1% | 3.6% | 0.7% | 0.0% | 2.2% | 4.3% |
| SF 1000-1500 | 3.3% | 5.7% | 2.9% | 1.6% | 3.7% | 3.8% | 3.6% |
| MF>1500 | 1.1% | 1.3% | 0.7% | 0.0% | 0.0% | 0.8% | 1.0% |
| SF>1500 | 10.7% | 22.6% | 39.6% | 55.8% | 93.7% | 38.2% | 23.4% |
| under 1500 SF | 15.2% | 18.1% | 23.5% | 20.6% | 11.2% | 20.1% | 17.5% |
| over 1500 SF | 8.5% | 22.5% | 33.7% | 58.7% | 77.1% | 35.9% | 21.1% |
| multifamily | 14.3% | 5.9% | 4.6% | 0.7% | 0.0% | 4.2% | 9.6% |
| single-family | 14.4% | 28.8% | 42.5% | 57.9% | 97.4% | 42.3% | 27.3% |
| no central air | 71.3% | 65.3% | 52.9% | 41.4% | 2.6% | 53.5% | 63.1% |
| <1000 sq ft mf | 21.2% | 3.3% | 0.6% | 0.0% | 0.0% | 1.6% | 12.1% |
| <1000 sq ft sf | 9.5% | 1.4% | 0.5% | 0.2% | 0.0% | 0.8% | 5.5% |
| 1000-1500 sq ft mf | 10.8% | 7.6% | 1.6% | 0.5% | 0.0% | 3.8% | 7.6% |
| 1000-1500 sq ft sf | 12.4% | 22.6% | 7.0% | 2.0% | 0.0% | 12.3% | 12.3% |
| > 1500 sq ft mf | 2.4% | 1.4% | 1.4% | 0.0% | 0.0% | 1.1% | 1.8% |
| > 1500 sq ft sf | 15.0% | 29.1% | 41.8% | 38.7% | 2.6% | 33.9% | 23.7% |
| under 1500 SF | 15.2% | 18.1% | 23.5% | 20.6% | 11.2% | 20.1% | 17.5% |
| over 1500 SF | 8.5% | 22.5% | 33.7% | 58.7% | 77.1% | 35.9% | 21.1% |
| multifamily | 34.3% | 12.2% | 3.7% | 0.5% | 0.0% | 6.5% | 21.5% |
| single-family | 36.9% | 53.1% | 49.3% | 40.9% | 2.6% | 47.0% | 41.6% |

Over 64% of the central air conditioners found among small users are in dwellings under 1500 square feet (that require less space conditioning per square foot) and 50% are in multi-family dwellings (that also require less space conditioning because of common walls with other dwellings). By comparison among customers who use more than 130% of baseline, only 36% of their central air conditioners are in dwellings under 1500 square feet and only 9% are in multifamily dwellings.

The Figure below shows the percentage of customers with use in each tier by dwelling type and type of air conditioner. It shows that 74% of customers in apartments with no air conditioning end up below 130% of baseline, while only 5 % of customers with central air conditioning in single-family houses end up below 130% of baseline.

Figure 7: Percentage in Tiers by Type of Air Conditioner and Dwelling Type, SDG&E



In sum, demand response potential is considerably smaller among customers using less than 130% of the baseline quantity, not just because they are small users, but because their use is less weather-sensitive than average, with more of the use being accounted for with lighting, refrigeration, and electronic equipment. Their average energy use per month is 256 kWh (0.35 average kW per hour). Their annual load patterns are flat (with only 7% using 30% more in the summer than in shoulder months). Almost 64% have no air conditioning at all; and, among the 29% with central air conditioning, disproportionate numbers of small customers live in smaller dwellings and multifamily dwellings that use less energy.

Finally, we look at income and household size to look at distributional equity issues. Usage increases dramatically as income rises, as shown in the next two charts.

Table 36: Income Characteristics of Customers in Each Summer Tier

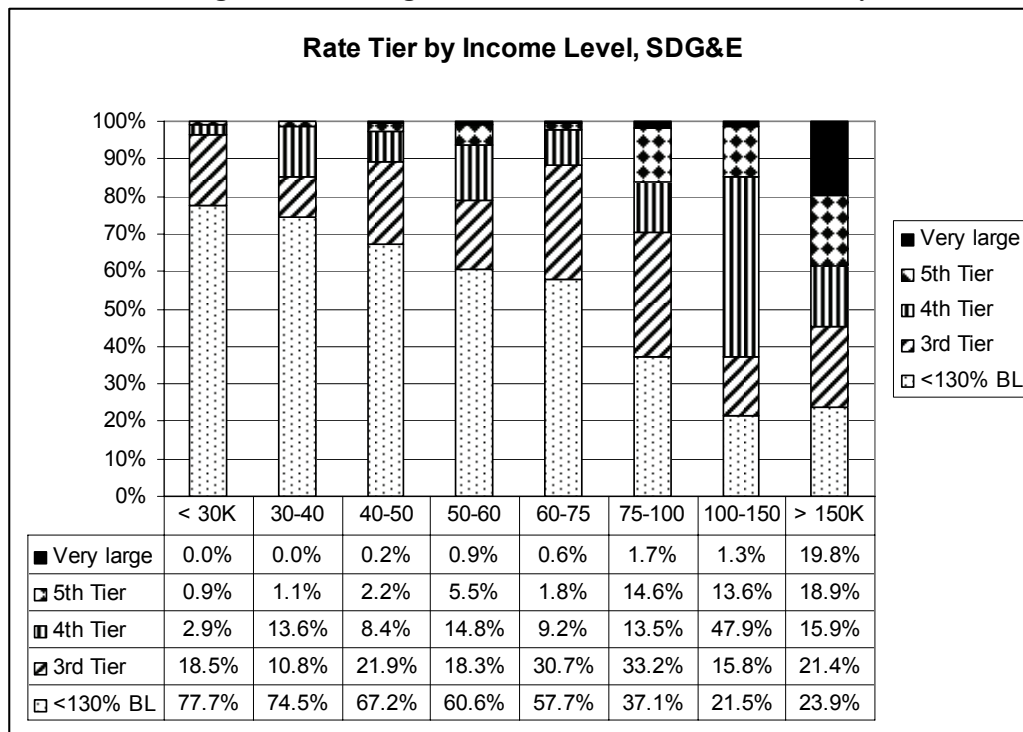
| <u>Approximate rate tier</u> | <425 | 425-600 | 600-900 | 900-1500 | >1500 | Over | Average |
|------------------------------|----------|----------|----------|----------|------------|---------|---------|
| | <130% BL | 3rd Tier | 4th Tier | 5th Tier | Very large | 130% BL | |
| < 30K | 35.5% | 21.8% | 4.4% | 3.6% | 0.0% | 11.4% | 24.4% |
| 30-40 | 16.9% | 6.3% | 10.4% | 2.1% | 0.0% | 6.6% | 12.1% |
| 40-50 | 7.5% | 6.4% | 3.2% | 2.1% | 0.7% | 4.2% | 6.0% |
| 50-60 | 6.3% | 4.9% | 5.2% | 4.7% | 2.2% | 4.8% | 5.6% |
| 60-75 | 16.1% | 22.1% | 8.7% | 4.2% | 4.0% | 13.3% | 14.8% |
| 75-100 | 7.5% | 17.3% | 9.2% | 24.3% | 8.5% | 15.5% | 11.2% |
| 100-150 | 6.7% | 12.8% | 50.7% | 35.3% | 9.9% | 29.7% | 17.3% |
| > 150 K | 3.6% | 8.3% | 8.1% | 23.6% | 74.7% | 14.4% | 8.6% |
| average income (\$'000) | 50.7 | 72.7 | 100.4 | 114.5 | 154.8 | 94.1 | 70.7 |

The average income of customers using less than 130% of baseline is \$50,200, compared to \$94,100 for those using more than 130% of baseline and \$122,500 for Tier 5 users.

Over 52% of small users have an income of less than \$40,000, compared to 18% of those using more than baseline and 6% of those in Tier 5.

Conversely, 10% of small users have an income over \$100,000, compared to 44% of those using more than 130% of baseline, 63% of Tier 5 users, and 85% of those using over 1500 kWh per month..

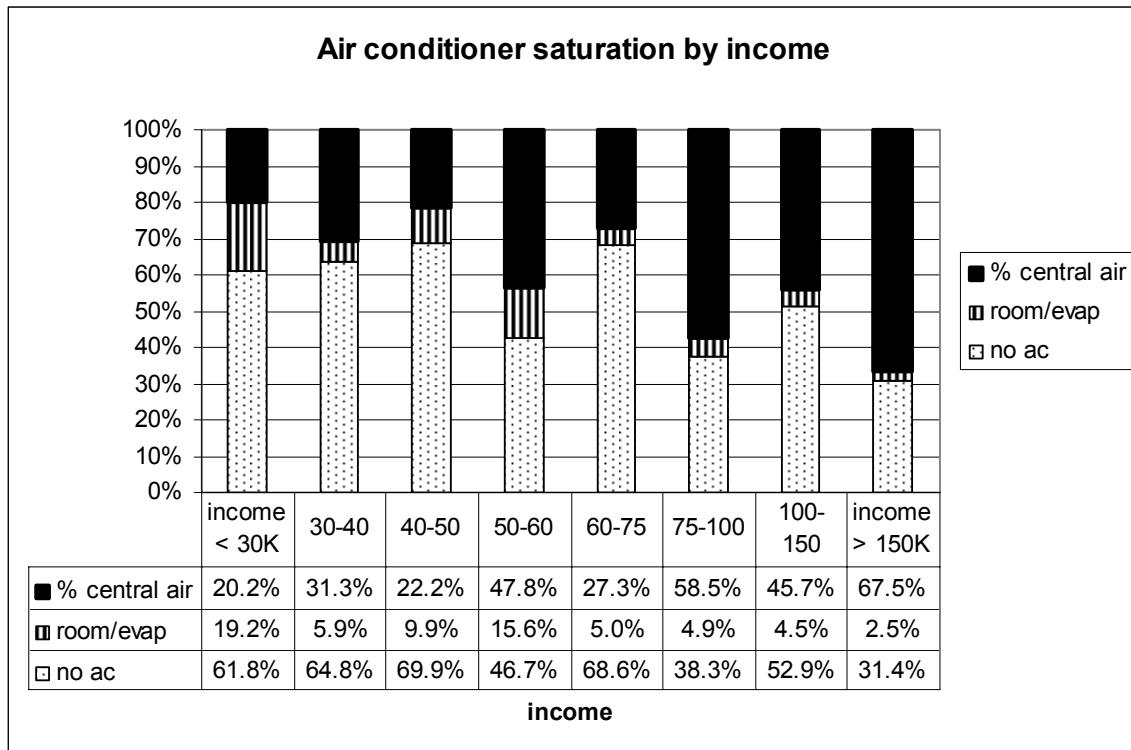
Figure 8: Percentage of SDG&E Customers in Each Tier by Income



In each income level up to \$75,000, at least 57% are small customers, compared to about 37% of those between \$75,000 and \$100,000 and about 22% of those earning over \$100,000. The percentage of customers reaching Tier 5 goes from less than 1% among those earning less than \$30,000 to 38.7% of those earning over \$150,000.

Part of the reason is that central air conditioner saturation rises rapidly with income – from 20% of those with less than \$30,000 to 67.5% of those with more than \$150,000.

Figure 9: SDG&E Air Conditioner Saturation by Income



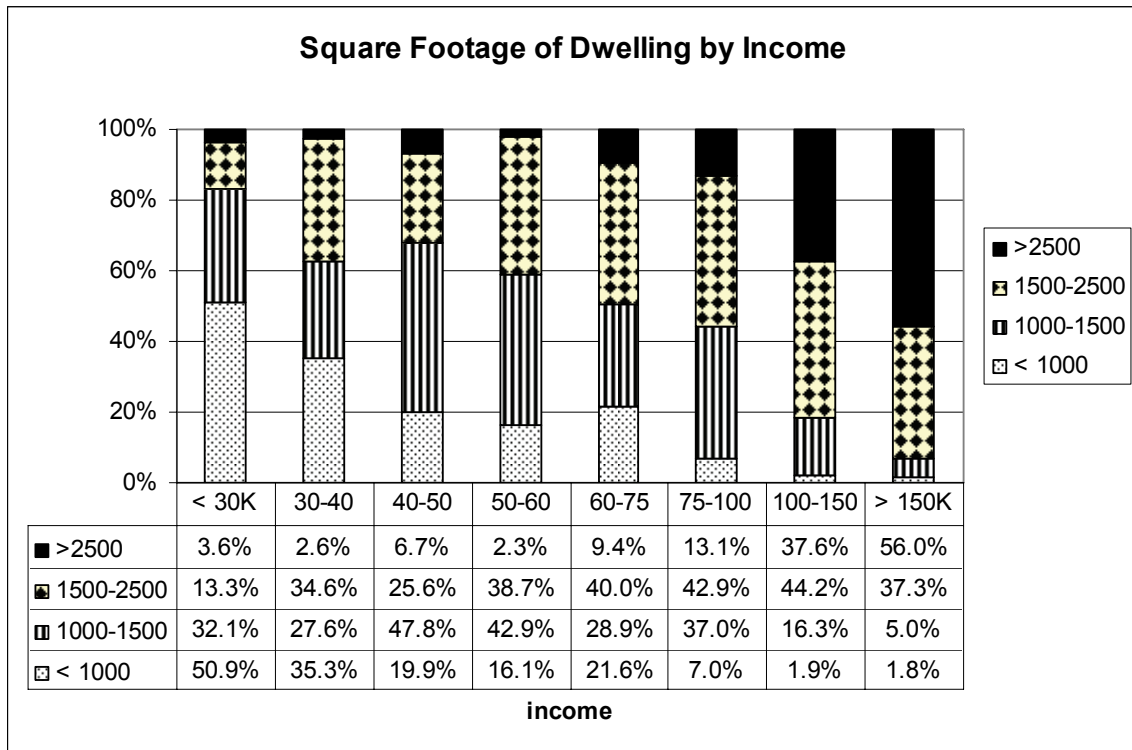
In addition, as can be expected, more well-to-do households own a higher percentage of larger dwellings and a higher percentage of single-family dwellings, thus using more energy.

Table 37: Percentage of Multifamily Customers by Income

| | % multifamily |
|---------|---------------|
| < 30K | 55.7% |
| 30-40 | 38.5% |
| 40-50 | 45.4% |
| 50-60 | 41.2% |
| 60-75 | 23.0% |
| 75-100 | 19.5% |
| 100-150 | 10.6% |
| > 150 K | 4.0% |

Multifamily dwellers fall from 56% of households below \$30,000 to less than 4% above \$150,000.

Figure 10: Square Footage of Dwelling by Income, SDG&E



The size of dwelling also increases with income – 51% of those with less than \$30,000 of income live in a space of less than 1000 square feet, while 56% of those making more than \$150,000 dwell in more than 2500 square feet.

Usage also generally increases with household size.

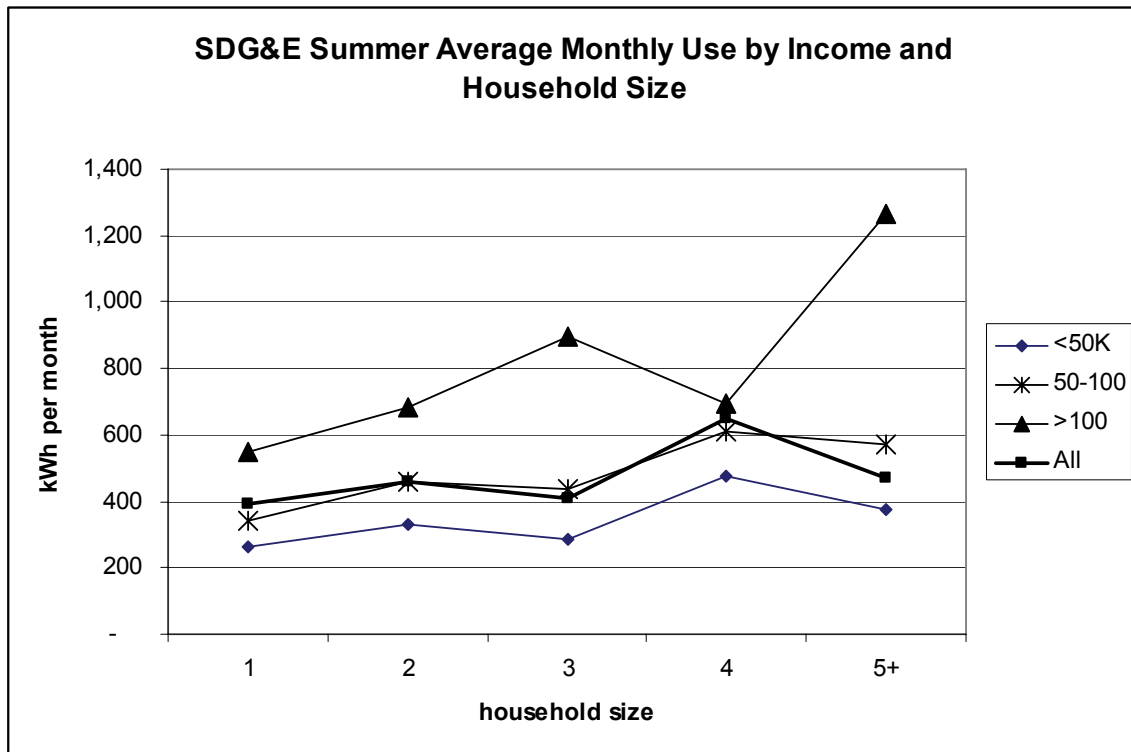
Table 38: Percentage of Customers in Each Tier by Number of persons in Household

| <u>Approximate rate tier</u> | <425 <130% BL | 425-600 3rd Tier | 600-900 4th Tier | 900-1500 5th Tier | >1500 Very large | Over 425 kWh | Average |
|-------------------------------------|------------------|---------------------|---------------------|----------------------|---------------------|-----------------|---------|
| Household 1 | 29.0% | 10.0% | 5.0% | 5.3% | 21.0% | 8.0% | 19.3% |
| Household 2 | 35.8% | 32.3% | 33.5% | 35.7% | 13.6% | 32.4% | 34.3% |
| Household 3 | 14.6% | 16.5% | 19.0% | 14.1% | 26.2% | 17.3% | 15.8% |
| Household 4 | 8.0% | 24.6% | 27.1% | 28.4% | 14.5% | 25.7% | 16.2% |
| Household 5 or more | 12.6% | 16.6% | 15.4% | 16.5% | 24.6% | 16.6% | 14.4% |

29% of small users are single-person households, compared to 8% of those using more than 130% of baseline, while only a low percentage of under 130% of baseline consist of households with 5 or more persons. Over 40% of five person households reach Tier 5.

However, a significant reason why usage increases with household size is that electricity use among the wealthiest of SDG&E’s customers rises dramatically as family size increases. As in our previous study, we found that very high income SDG&E customers use more electricity than would be predicted by simply including income and family-size variables. The inclusion of an indicator variable for large high-income families has strong explanatory power, as shown below.

Figure 11: Average Monthly Summer Month Use by Income and Household Size, SDG&E



C. Findings and Conclusions

Those SDG&E customers whose usage falls under 130% of baseline quantities in the summer months have limited demand response potential because:

1. They use considerably less energy to start with – 257 kWh per summer month, compared to 1,358 kWh per month among fifth tier users and 720 kWh per month among all customers using more than 130% of baseline.
2. Only 7% of them have a peaked load pattern (more than 30% more use in the peak summer months than in shoulder months)
3. They live in dwellings that use less energy, particularly for heating and cooling. 49% are in multifamily units (compared to 11% of those above 130% of baseline) and 38% live in dwellings of less than 1000 square feet.

4. Almost 64% of them have no air conditioning at all.
5. Of the 29% who do have central air conditioning vs. 47% above 130% of baseline) only 36% live in dwellings bigger than 1500 square feet (compared to 64% of those with central air who use more than 130% of baseline);
6. They have fewer discretionary appliances. Percentages of the under 130% of baseline customer group that have pools, home laundries and electric stoves are considerably smaller than the over 130% of baseline group. Only 2.4% of small customers have pools, contrasted with 84% of very large customers.

Those using less than 130% of baseline have a household income averaging \$50,700 in 2002. Those using over 130% of baseline had an average income that was 85% higher at \$94,100. Over half of those using less than 130% of baseline had an income of less than \$40,000, compared to 18% of those using over 130% of baseline. These income differentials among electric users of varying sizes are largely explained by the same factors that make small customers poor candidates for demand response – a larger percentage of multifamily dwellers, smaller sized housing units, fewer discretionary appliances, and a considerably lower saturation of air conditioning as income declines.