

# Energy & Science



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## Section 7

# ENERGY & SCIENCE

The increase in Maui County's population has been reflected in the utilities. Consumption and use of electricity, gas, utilities, and water have all increased dramatically over the last decade. Statistics on electricity, gas, water production and consumption are covered. Hawaiian Commercial and Sugar sells excess electricity to Maui Electric Company, meeting about 10% of the power needs of Maui's homes and businesses.

Ongoing scientific endeavors include observation of astronomical and man-made space objects from the summit of Mt. Haleakala.

## 7.1.1

### TELESCOPES AT THE SUMMITS OF MAUNA KEA AND HALEAKALA

| Location and Facility                           | Mirror Size<br>(meters) | Year<br>Completed | Primary Use                | Local<br>Staff <sup>1</sup> |
|---|-------------------------|-------------------|----------------------------|-----------------------------|
| <b>Mauna Kea</b>                                |                         |                   |                            |                             |
| UH 24-inch Telescope                            | 0.6                     | 1968              | Optical                    |                             |
| UH 88-inch Telescope*                           | 2.2                     | 1970              | Optical/infrared           | 8                           |
| NASA Infrared Telescope Facility                | 3.0                     | 1979              | Infrared                   | 12                          |
| Canada-France-Hawaii Telescope                  | 3.6                     | 1979              | Optical/infrared           | 50                          |
| United Kingdom Infrared Telescope               | 3.8                     | 1979              | Infrared                   | 31                          |
| W. M. Keck Observatory (Keck I)                 | 10                      | 1992              | Optical/infrared           |                             |
| W. M. Keck Observatory (Keck II)                | 10                      | 1996              | Optical/infrared           | 85 (total)                  |
| Subaru  | 8                       | 1999              | Optical/infrared           | 30                          |
| Gemini Northern 8-meter Telescope               | 8                       | 1999              | Optical/infrared           | 30                          |
| Caltech Submillimeter Observatory               | 10.4                    | 1986              | mm/submm                   | 10                          |
| James Clerk Maxwell Telescope                   | 15                      | 1986              | mm/submm                   | 43                          |
| Submillimeter Array                             | 8 antennae @ 6 m        | 1999              | submillimeter              | 26                          |
| Very Long Baseline Array                        | 25                      | 1992              | centimeter                 | 2                           |
| <b>Haleakala (on University of Hawaii land)</b> |                         |                   |                            |                             |
| Mees Solar Observatory                          |                         | 1956              | Measure solar emissions    | 2                           |
| Laser Ranging Facility                          |                         | 1976/84           | Laser ranging              | 7                           |
| Maui Space Surveillance Site                    |                         |                   |                            | 120                         |
| Tracking Telescope (compensated)                | 1.6                     | 1968              | Image near earth objects   |                             |
| Dual Tracking Telescope                         | 1.2                     | 1968              | Track satellites           |                             |
| Coudé Beam Director                             | 0.8                     | 1987              | Project laser beams        |                             |
| Beam Director                                   | 0.6                     | 1975              | Project laser beams        |                             |
| Advanced Electro-Optical System (AEOS)          | 3.7                     | 1999              | Track satellites           | 55                          |
| MAGNUM Telescope <sup>2</sup>                   | 2.0                     | 2001              | Monitor Galactic Distances | 1                           |
| Faulkes Telescope <sup>3</sup>                  | 2.0                     | 2003              | Education                  | n/a                         |
| GEODSS  |                         |                   | Track deep space objects   |                             |
| Primary   | 1                       | 1982              |                            |                             |
| Secondary                                       | 1                       | 1982              |                            |                             |
| Auxiliary                                       | 0.4                     | 1982              |                            |                             |

<sup>1</sup> Based in same county as observatory.

<sup>2</sup> MAGNUM = Multicolor Active Galactic Nuclei Monitoring

<sup>3</sup> Under Constuction

\* University of Hawaii

SOURCE: University of Hawai'i at Manoa, Institute for Astronomy, *1998 Fact Sheet*, and records.

## 7.1.2

## ELECTRIC UTILITIES, MAUI COUNTY

|   | 1998             | 1999             | 2000             | 2001             | 2002             |
|---|------------------|------------------|------------------|------------------|------------------|
| <b>CUSTOMERS, DEC. 31</b>                                     |                  |                  |                  |                  |                  |
| <i>Total</i>  |                  |                  |                  |                  |                  |
| Maui Island   | 51,035           | 52,079           | 53,204           | 54,405           | 55,504           |
| Molokai   | 2,870            | 2,911            | 2,903            | 2,926            | 2,960            |
| Lanai   | 1,381            | 1,420            | 1,494            | 1,509            | 1,519            |
| <b>Maui County</b>  | <b>55,286</b>    | <b>56,410</b>    | <b>57,601</b>    | <b>58,840</b>    | <b>59,983</b>    |
| <i>Residential<sup>1</sup></i>                                |                  |                  |                  |                  |                  |
| Maui Island   | 43,694           | 44,510           | 45,379           | 46,320           | 47,253           |
| Molokai   | 2,338            | 2,364            | 2,351            | 2,381            | 2,416            |
| Lanai   | 1,200            | 1,227            | 1,296            | 1,306            | 1,310            |
| <b>Maui County</b>  | <b>47,232</b>    | <b>48,101</b>    | <b>49,026</b>    | <b>50,007</b>    | <b>50,979</b>    |
| <i>Other</i>  |                  |                  |                  |                  |                  |
| Maui Island   | 7,341            | 7,569            | 7,825            | 8,085            | 8,251            |
| Molokai   | 532              | 547              | 552              | 545              | 544              |
| Lanai   | 181              | 193              | 198              | 203              | 209              |
| <b>Maui County</b>  | <b>8,054</b>     | <b>8,309</b>     | <b>8,575</b>     | <b>8,833</b>     | <b>9,004</b>     |
| <b>GENERATING AND FIRM PURCHASED CAPABILITY, DEC. 31 (MW)</b> |                  |                  |                  |                  |                  |
| Maui Island   | 233.2            | 228.9            | 250.1            | 250.1            | 250.1            |
| Molokai   | 12.1             | 12.1             | 12.1             | 12.1             | 12.0             |
| Lanai   | 10.4             | 10.4             | 10.4             | 10.4             | 10.4             |
| <b>Maui County</b>  | <b>255.7</b>     | <b>251.4</b>     | <b>272.6</b>     | <b>272.6</b>     | <b>272.5</b>     |
| <b>PEAK DEMAND (MW)<sup>2</sup></b>                           |                  |                  |                  |                  |                  |
| Maui Island   | 176.0            | 180.1            | 185.1            | 191.0            | 193.9            |
| Molokai   | 6.6              | 7.0              | 6.5              | 6.5              | 6.6              |
| Lanai   | 5.2              | 5.0              | 5.0              | 5.2              | 4.9              |
| <b>POWER SOLD (1,000 kWh)</b>                                 |                  |                  |                  |                  |                  |
| <i>Total</i>  |                  |                  |                  |                  |                  |
| Maui Island   | 967,760          | 1,002,594        | 1,042,006        | 1,071,486        | 1,096,739        |
| Molokai   | 34,710           | 35,576           | 36,349           | 35,681           | 34,942           |
| Lanai   | 26,085           | 26,569           | 27,108           | 26,905           | 27,036           |
| <b>Maui County</b>  | <b>1,028,556</b> | <b>1,064,739</b> | <b>1,105,463</b> | <b>1,134,072</b> | <b>1,158,717</b> |
| <i>Residential</i>  |                  |                  |                  |                  |                  |
| Maui Island   | 328,598          | 340,071          | 354,689          | 360,025          | 378,828          |
| Molokai   | 12,567           | 12,551           | 12,687           | 12,348           | 12,439           |
| Lanai   | 6,577            | 6,620            | 6,855            | 7,068            | 7,358            |
| <b>Maui County</b>  | <b>347,742</b>   | <b>359,243</b>   | <b>374,231</b>   | <b>379,440</b>   | <b>398,625</b>   |
| <i>Other</i>  |                  |                  |                  |                  |                  |
| Maui Island   | 639,162          | 662,523          | 687,317          | 711,462          | 717,911          |
| Molokai   | 22,144           | 23,025           | 23,661           | 23,333           | 22,503           |
| Lanai   | 19,508           | 19,949           | 20,253           | 19,838           | 19,678           |
| <b>Maui County</b>  | <b>680,814</b>   | <b>705,496</b>   | <b>731,232</b>   | <b>754,633</b>   | <b>760,092</b>   |

## 7.1.2

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|   | 1998           | 1999           | 2000           | 2001           | 2002           |
|---|----------------|----------------|----------------|----------------|----------------|
| <b>AVERAGE ANNUAL USE (kWh)<sup>3</sup></b> |                |                |                |                |                |
| <i>Residential</i>                          |                |                |                |                |                |
| Maui Island                                 | 7,520          | 7,640          | 7,816          | 7,773          | 8,017          |
| Molokai                                     | 5,375          | 5,309          | 5,397          | 5,186          | 5,149          |
| Lanai                                       | 5,481          | 5,396          | 5,289          | 5,412          | 5,617          |
| <b>Maui County</b>                          | <b>7,362</b>   | <b>7,469</b>   | <b>7,633</b>   | <b>7,588</b>   | <b>7,819</b>   |
| <i>Other</i>                                |                |                |                |                |                |
| Maui Island                                 | 87,067         | 87,531         | 87,836         | 87,998         | 87,009         |
| Molokai                                     | 41,623         | 42,093         | 42,865         | 42,814         | 41,366         |
| Lanai                                       | 107,779        | 103,361        | 102,288        | 97,722         | 94,152         |
| <b>Maui County</b>                          | <b>84,531</b>  | <b>84,907</b>  | <b>85,275</b>  | <b>85,433</b>  | <b>84,417</b>  |
| <b>AVERAGE RATE (dollars per kWh)</b>       |                |                |                |                |                |
| <i>Residential</i>                          |                |                |                |                |                |
| Maui Island                                 | 0.13956        | 0.15549        | 0.18232        | 0.18656        | 0.17119        |
| Molokai                                     | 0.18328        | 0.19547        | 0.22787        | 0.23631        | 0.22173        |
| Lanai                                       | 0.17967        | 0.19478        | 0.22184        | 0.24415        | 0.22445        |
| <b>Maui County</b>                          | <b>0.14190</b> | <b>0.15761</b> | <b>0.18459</b> | <b>0.18925</b> | <b>0.17375</b> |
| <i>Other</i>                                |                |                |                |                |                |
| Maui Island                                 | 0.12488        | 0.13866        | 0.16582        | 0.17125        | 0.15684        |
| Molokai                                     | 0.17440        | 0.19053        | 0.22376        | 0.22841        | 0.21110        |
| Lanai                                       | 0.18451        | 0.19737        | 0.22112        | 0.24555        | 0.22480        |
| <b>Maui County</b>                          | <b>0.12820</b> | <b>0.14201</b> | <b>0.16922</b> | <b>0.17497</b> | <b>0.16020</b> |
| <b>Revenues (\$1,000)</b>                   |                |                |                |                |                |
| <i>Total</i>                                |                |                |                |                |                |
| Maui Island                                 | 125,677        | 144,741        | 178,638        | 189,003        | 177,446        |
| Molokai                                     | 6,165          | 6,840          | 8,186          | 8,247          | 7,508          |
| Lanai                                       | 4,781          | 5,227          | 5,999          | 6,597          | 6,075          |
| <b>Maui County</b>                          | <b>136,623</b> | <b>156,808</b> | <b>192,823</b> | <b>203,847</b> | <b>191,030</b> |
| <i>Residential</i>                          |                |                |                |                |                |
| Maui Island                                 | 45,860         | 52,878         | 64,668         | 67,166         | 64,851         |
| Molokai                                     | 2,303          | 2,453          | 2,891          | 2,918          | 2,758          |
| Lanai                                       | 1,182          | 1,290          | 1,521          | 1,726          | 1,652          |
| <b>Maui County</b>                          | <b>49,345</b>  | <b>56,621</b>  | <b>69,080</b>  | <b>71,809</b>  | <b>69,260</b>  |
| <i>Other</i>                                |                |                |                |                |                |
| Maui Island                                 | 79,817         | 91,863         | 113,970        | 121,837        | 112,596        |
| Molokai                                     | 3,862          | 4,387          | 5,294          | 5,330          | 4,750          |
| Lanai                                       | 3,599          | 3,937          | 4,478          | 4,871          | 4,424          |
| <b>Maui County</b>                          | <b>87,278</b>  | <b>100,187</b> | <b>123,743</b> | <b>132,038</b> | <b>121,769</b> |

<sup>1</sup> Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents, which are classified as commercial customers.

<sup>2</sup> Peak demand is the maximum amount of energy required from the electrical system. The islands' electrical systems are not interconnected, so no peaks are reported for Maui County as a whole.

<sup>3</sup> Based on number of customers at end of year.

SOURCE: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records; capacity and peak demand: Hawaiian Electric Industries, Inc., Securities and Exchange Commission 10-K filings, 1998-2002.

### 7.1.3

## GAS UTILITIES, MAUI COUNTY

*Excludes bottled gas*

|  | 1998    | 1999    | 2000    | 2001    | 2002    |
|--|---------|---------|---------|---------|---------|
| <b>Island of Maui</b>                          |         |         |         |         |         |
| <b>Customers (December 31)</b>                 |         |         |         |         |         |
| Residential <sup>1</sup>                       | 319     | 326     | 333     | 329     | 325     |
| Other  | 77      | 79      | 78      | 79      | 75      |
| Total  | 396     | 405     | 411     | 408     | 400     |
| <b>Gas Sold (1,000 therms)</b>                 |         |         |         |         |         |
| Residential                                    | 71      | 74      | 78      | 77      | 68      |
| Other  | 682     | 813     | 805     | 786     | 771     |
| Total  | 752     | 887     | 883     | 863     | 839     |
| <b>Average Annual Use (therms)</b>             |         |         |         |         |         |
| Residential                                    | 221     | 228     | 233     | 234     | 210     |
| Other  | 8,852   | 10,285  | 10,320  | 9,947   | 10,281  |
| <b>Average Rate (\$ per therm)<sup>2</sup></b> |         |         |         |         |         |
| Residential                                    | 2.15527 | 1.98769 | 2.10372 | 2.43086 | 2.71343 |
| Other  | 1.21693 | 1.14251 | 1.23916 | 1.45250 | 1.36960 |
| <b>Revenues (\$1,000)</b>                      |         |         |         |         |         |
| Residential                                    | 152     | 148     | 163     | 187     | 185     |
| Other  | 829     | 928     | 997     | 1,141   | 1,056   |
| Total  | 982     | 1,076   | 1,161   | 1,329   | 1,241   |
| <b>Island of Molokai<sup>3</sup></b>           |         |         |         |         |         |
| <b>Customers (December 31)</b>                 |         |         |         |         |         |
| Total/Residential                              | 96      | 92      | 78      | 71      | 80      |
| <b>Gas Sold (1,000 therms)</b>                 |         |         |         |         |         |
| Total/Residential                              | 20      | 19      | 17      | 15      | 14      |
| <b>Average Annual Use (therms)</b>             |         |         |         |         |         |
| Total/Residential                              | 205     | 206     | 220     | 205     | 117     |
| <b>Average Rate (\$ per therm)</b>             |         |         |         |         |         |
| Total/Residential                              | 2.31461 | 2.23825 | 2.33821 | 2.62590 | 2.84208 |
| <b>Revenues (\$1,000)</b>                      |         |         |         |         |         |
| Total/Residential                              | 46      | 42      | 40      | 38      | 40      |

<sup>1</sup> Residential refers to single-metered residential customers which may include condominiums for visitor use but excludes master-metered apartment and condominium buildings used by residents which are classified as commercial customers.

<sup>2</sup> Based on number of customers at end of year.

<sup>3</sup> All Molokai customers are residential.

SOURCE: Hawaii State Department of Commerce and Consumer Affairs, Division of Consumer Advocacy, records.

## 7.1.4

## HAWAII STATE ENERGY REPORT, ENERGY CONSUMPTION ESTIMATES BY SOURCE

*In billion BTU*

|   | 1995                  | 1996                  | 1997                  | 1998                  | 1999                  | 2000             |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------|
| Asphalt and road oil  | 2,906.9               | 2,663.4               | 2,629.6               | 2,138.0               | 2,340.3               | 4,009.3          |
| Aviation gasoline   | 1,099.8               | 833.0                 | 608.8                 | 540.3                 | 293.6                 | 226.3            |
| Distillate fuel   | 29,226.6              | 25,736.6              | 24,973.5              | 25,298.4              | 26,252.0              | 26,439.5         |
| Kerosene-type jet fuel  | 56,283.6              | 57,171.9              | 57,921.6              | 56,643.3              | 53,720.0              | 53,510.8         |
| Naphtha-type jet fuel   | 74.0                  | 22.0                  | 9.0                   | 0.0                   | 0.0                   | 0.0              |
| Kerosene  | 2.9                   | 3.0                   | 2.8                   | 1.5                   | 0.9                   | 1.4              |
| Liquified petroleum gasses  | 4,769.6               | 4,766.4               | 870.3                 | 3,050.5               | 1,358.0               | 2,027.4          |
| Lubricants  | 557.7                 | 541.2                 | 571.7                 | 598.5                 | 604.8                 | 595.7            |
| Motor gasoline  | 49,103.4              | 48,892.3              | 48,781.1              | 48,692.3              | 46,653.8              | 48,397.8         |
| Residual fuel   | 77,631.9              | 65,253.6              | 62,112.4              | 69,319.4              | 69,910.5              | 75,291.2         |
| Other petroleum products <sup>1</sup>                                       | 13,052.7              | 15,488.5              | 15,257.4              | 12,595.3              | 12,615.2              | 11,806.6         |
| <b>Subtotal petroleum products</b>  | <b>234,709.2</b>      | <b>221,371.8</b>      | <b>213,738.2</b>      | <b>218,877.5</b>      | <b>213,749.1</b>      | <b>222,305.9</b> |
| Geothermal energy   | 4,992.4               | 5,120.0               | 4,683.3               | 4,983.0               | 4,437.1               | 5,515.6          |
| Solar thermal and photovoltaic energy                                       | 1,205.2               | 1,255.0               | 1,273.0               | 1,317.7               | 1,349.5               | 1,367.6          |
| Wind energy   | 91.2                  | 123.7                 | 206.2                 | 199.5                 | 170.6                 | 173.4            |
| <b>Subtotal geothermal, solar thermal,<br/>photovoltaic and wind energy</b> | <b>6,288.8</b>        | <b>6,498.6</b>        | <b>6,162.4</b>        | <b>6,500.2</b>        | <b>5,957.2</b>        | <b>7,056.6</b>   |
| Coal  | 19,914.4 <sup>r</sup> | 20,368.5 <sup>r</sup> | 20,040.3 <sup>r</sup> | 18,706.7 <sup>r</sup> | 17,691.3 <sup>r</sup> | 17,661.0         |
| Hydroelectric power   | 1,008.6               | 1,082.6               | 1,194.5               | 1,254.7               | 1,216.3               | 1,055.4          |
| Natural gas   | 2,906.1               | 2,824.3               | 2,688.3               | 2,803.7               | 2,886.5               | 2,975.0          |
| Wood and waste  | 8,008.9               | 15,996.8              | 14,779.2              | 13,301.8              | 14,571.1              | 13,782.2         |
| <b>Total energy consumption</b>   | <b>257,041.0</b>      | <b>251,411.7</b>      | <b>241,824.9</b>      | <b>246,585.5</b>      | <b>241,444.5</b>      | <b>264,836.0</b> |

NOTE: Totals may not equal sum of components due to independent rounding.

<sup>1</sup> Other petroleum products are aviation gasoline blending components, motor gasoline blending components, petroleum coke, still gas, unfinished oils, and petroleum waxes.

r: Revised

SOURCE: U.S. Department of Energy, Energy Information Administration, Combined State Energy Data System 2000.

