## Fiscal Year 2014 Cornell University Central Energy Plant (CEP) Fast Facts<sup>1</sup>

| Primary Consumption (trillion Btu)   | CEP PRIMARY ENERGY CON   | SUMPTION                            |                               |
|--|--|-------------------------------------|-------------------------------|
| Electricity (Grid Purchased)   |  |                                     | 2014                          |
| Hydro (electric)   Natural Gas   0.28   2.74   0.01   1.014   0.03   1.025   2.98   1.025   2.025   1.025   2.98   1.025   2.025   1.025   |  | 0.60                                | 0.19                          |
| Natural Gas  | Coal   | 1.33                                | 0.00                          |
| Oii  | Hydro (electric)   | 0.02                                | 0.01                          |
| Total Primary Energy Consumption   2.35   2.98   | Natural Gas  | 0.28                                | 2.74                          |
| CENTRAL ENERGY PLANT EFFICIENCY  |  |                                     | 0.03                          |
| Energy Output (trillion Btu)   | Total Primary Energy Consumption   | 2.35                                | 2.98                          |
| Total Steam Generation   | CENTRAL ENERGY PLANT EFFICIENCY  |                                     |                               |
| Total Steam Generation   | Energy Output (trillion Btu)   | <u>1990</u>                         | <u>2014</u>                   |
| Total Energy Output  | Total Steam Generation   | 1.31                                | 1.40                          |
| Fuel Sources (trillion Btu)   1990   2014  |  | 0.07                                | 0.72                          |
| Coal   Natural Gas - Boilers   0.28   0.23   0.00   0.28   0.23   0.23   0.23   0.24   0.23   0.23   0.24   0.25   0.26   0.25   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.27   0.27   0.27   0.26   0.27 | Total Energy Output  | 1.38                                | 2.13                          |
| Coal   Natural Gas - Boilers   0.28   0.23   0.00   0.28   0.23   0.23   0.23   0.24   0.23   0.23   0.24   0.25   0.26   0.25   0.26   0.26   0.26   0.26   0.26   0.26   0.26   0.27   0.27   0.27   0.26   0.27 | Fuel Sources (trillion Btu)  | 1990                                | 2014                          |
| Natural Gas - Boilers   0.28   0.23     Natural Gas - Turbines   0.00   2.19     Natural Gas - Duct Burners   0.00   0.32     Oil   0.14   0.03     Total Energy Input (trillion Btu)   1.74   2.77     Total Central Plant Efficiency   68%   77%     Total Steam Sales (trillion Btu)   NA   1.01     Total Distrib and Building Steam Losses (%)   NA   19%     ELECTRICITY   Cornell Utilities Generated (Mwh)   1990   2014     Cornell Utilities Steam Turbine - Cogen   21,000   25,400     Cornell Utilities Gas Turbine - CCHPP(3)   0   187,100     Total Cornell Utilities Generated (Mwh)   175,000   21,000     Electricity Exported to Grid (Mwh)   175,000   52,200     Electricity (Grid Purchased) (Mwh)   175,000   52,200     Total Cep Electricity (Mwh)   201,200   230,300     Total Campus Sales (Mwh)   NA   216,000     Electricity LSC (Grid Purchased) (Mwh)   0   4,700     Electricity (Grid Purchased) Sources   1990   2014     Other Renewables   0%   4%     Coal   74%   15%     Natural Gas   5%   22%     Hydro   14%   28%     Nuclear   5%   29%     Petroleum   2%   11%     Other   0%   <1%     Total Chilled Water Production (trillion Btu)   0.338   0.526     Chilled Water Production (trillion Btu)   0.072   0.021     System Coefficient of Performance   4.7   25.00     Total Campus Sales (trillion Btu)   6,000   6,000     Chilled Water Sources   Mechanical Chillers   83.2%   2%  |  |                                     |                               |
| Natural Gas - Turbines         0.00         2.15           Natural Gas - Duct Burners         0.00         0.32           Oil         0.14         0.03           Total Energy Input (trillion Btu)         1.74         2.77           Total Central Plant Efficiency         68%         77%           Total Steam Sales (trillion Btu)         NA         1.01           Total Distrib and Building Steam Losses (%)         NA         1.99           ELECTRICITY         Cornell Utilities Generated (Mwh)         1.990         2.014           Cornell Utilities Steam Turbine - Cogen         21,000         25,400           Cornell Utilities Gas Turbine - CCHPP(3)         0         1.87,100           Total Cornell Utilities Generated         26,200         216,900           Electricity Exported to Grid (Mwh)         0         (38,800)           Electricity (Grid Purchased) (Mwh)         175,000         52,200           Total CEP Electricity (Mwh)         201,200         230,300           Total Campus Sales (Mwh)         175,000         52,200           Total Campus Sales (Mwh)         0         4,700           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%  |  |                                     | 0.23                          |
| Oil         0.14         0.03           Total Energy Input (trillion Btu)         1.74         2.77           Total Central Plant Efficiency         68%         77%           Total Steam Sales (trillion Btu)         NA         1.01           Total Distrib and Building Steam Losses (%)         NA         1.9%           ELECTRICITY         Cornell Utilities Generated (Mwh)         1990         2014           Cornell Utilities Generated (Mwh)         5,200         4,400         4,400         2,000         25,400         2,000   |  |                                     | 2.19                          |
| Total Energy Input (trillion Btu)         1.74         2.77           Total Central Plant Efficiency         68%         77%           Total Steam Sales (trillion Btu)         NA         1.01           Total Distrib and Building Steam Losses (%)         NA         19%           ELECTRICITY         S.200         4,400           Cornell Utilities Generated (Mwh)         1990         2014           Cornell Utilities Steam Turbine - Cogen         21,000         25,400           Cornell Utilities Gas Turbine - CCHPP(3)         0         187,100           Total Cornell Utilities Generated         26,200         216,900           Electricity Exported to Grid (Mwh)         0         (38,800)           Electricity (Grid Purchased) (Mwh)         175,000         52,200           Total Cep Electricity (Mwh)         201,200         230,300           Total Campus Sales (Mwh)         NA         216,000           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%  | Natural Gas - Duct Burners   | 0.00                                | 0.32                          |
| Total Central Plant Efficiency         68%         77%           Total Steam Sales (trillion Btu)         NA         1.01           Total Distrib and Building Steam Losses (%)         NA         19%           ELECTRICITY         Steam Losses (%)         NA         19%           Cornell Utilities Generated (Mwh)         5,200         4,400           Cornell Utilities Steam Turbine - Cogen         21,000         25,400           Cornell Utilities Gas Turbine - CCHPP(3)         0         187,100           Total Cornell Utilities Generated         26,200         216,900           Electricity Exported to Grid (Mwh)         0         (38,800)           Electricity (Grid Purchased) (Mwh)         175,000         52,200           Total CEP Electricity (Mwh)         175,000         52,200           Total Campus Sales (Mwh)         NA         216,000           Electricity (Scrid Purchased) (Mwh)         NA         216,000           Electricity (Grid Purchased) (Mwh)         0         4,700           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro  | Oil  | 0.14                                | 0.03                          |
| Total Steam Sales (trillion Btu)         NA         1.01           Total Distrib and Building Steam Losses (%)         NA         19%           ELECTRICITY         Cornell Utilities Generated (Mwh)         1990         2014           Cornell Utilities Hydro         5,200         4,400           Cornell Utilities Steam Turbine - Cogen         21,000         25,400           Cornell Utilities Gas Turbine - CCHPP(3)         0         187,100           Total Cornell Utilities Generated         26,200         216,900           Electricity Exported to Grid (Mwh)         0         (38,800)           Electricity (Grid Purchased) (Mwh)         175,000         52,200           Total CEP Electricity (Mwh)         175,000         52,200           Total Campus Sales (Mwh)         NA         216,000           Electricity LSC (Grid Purchased) (Mwh)         NA         216,000           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1% <td>Total Energy Input (trillion Btu)</td> <td>1.74</td> <td>2.77</td>   | Total Energy Input (trillion Btu)  | 1.74                                | 2.77                          |
| Total Distrib and Building Steam Losses (%)  | Total Central Plant Efficiency   | 68%                                 | 77%                           |
| Total Distrib and Building Steam Losses (%)  | Total Steam Sales (trillion Btu)   | NA                                  | 1 01                          |
| Cornell Utilities Generated (Mwh)  | ,  |                                     | _                             |
| Cornell Utilities Generated (Mwh)         1990         2014           Cornell Utilities Hydro         5,200         4,400           Cornell Utilities Steam Turbine - Cogen         21,000         25,400           Cornell Utilities Gas Turbine - CCHPP(3)         0         187,100           Total Cornell Utilities Generated         26,200         216,900           Electricity Exported to Grid (Mwh)         0         (38,800)           Electricity (Grid Purchased) (Mwh)         175,000         52,200           Total CEP Electricity (Mwh)         201,200         230,300           Total Campus Sales (Mwh)         NA         216,000           Electricity (Grid Purchased) (Mwh)         0         4,700           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%   |  | 14/3                                | 1370                          |
| Cornell Utilities Hydro   5,200   4,400   Cornell Utilities Steam Turbine - Cogen   Cornell Utilities Gas Turbine - CCHPP(3)   0   187,100   187 |  | 1990                                | 2014                          |
| Cornell Utilities Steam Turbine - Cogen Cornell Utilities Gas Turbine - CCHPP(3)   |  |                                     |                               |
| Cornell Utilities Gas Turbine - CCHPP <sup>(3)</sup> 0         187,100           Total Cornell Utilities Generated         26,200         216,900           Electricity Exported to Grid (Mwh)         0         (38,800)           Electricity (Grid Purchased) (Mwh)         175,000         52,200           Total CEP Electricity (Mwh)         201,200         230,300           Total Campus Sales (Mwh)         NA         216,000           Electricity LSC (Grid Purchased) (Mwh)         0         4,700           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%   | •  |                                     | -                             |
| Electricity Exported to Grid (Mwh)   0 (38,800)  | <del>_</del>   |                                     | -                             |
| Electricity (Grid Purchased) (Mwh)   |  |                                     | 216,900                       |
| Electricity (Grid Purchased) (Mwh)   | Floatricity Exported to Crid (Mush)  | 0                                   | (20.000)                      |
| Total CEP Electricity (Mwh)         201,200         230,300           Total Campus Sales (Mwh)         NA         216,000           Electricity LSC (Grid Purchased) (Mwh)         0         4,700           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%   |  | _                                   | , ,                           |
| Total Campus Sales (Mwh)         NA         216,000           Electricity LSC (Grid Purchased) (Mwh)         0         4,700           Electricity (Grid Purchased) Sources         1990         2014           Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%   |  |                                     |                               |
| Electricity LSC (Grid Purchased) (Mwh)   | , , , ,  |                                     |                               |
| Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%   |  |                                     | 4,700                         |
| Other Renewables         0%         4%           Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%   | Flootrinity (Crid Durahaged) Sources   | 1000                                | 2014                          |
| Coal         74%         15%           Natural Gas         5%         22%           Hydro         14%         28%           Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%  |  |                                     |                               |
| Natural Gas  | o in or i to no madros   |                                     |                               |
| Hydro  |  |                                     |                               |
| Nuclear         5%         29%           Petroleum         2%         1%           Other         0%         <1%  |  |                                     |                               |
| Petroleum         2%         1%           Other         0%         <1%   | •  |                                     |                               |
| Other         0%         <1%           Total         100%         100%           CHILLED WATER           Energy Output & Input (trillion Btu)         1990         2014           Total Chilled Water Production (trillion Btu)         0.338         0.526           Total Energy Input (trillion Btu) <sup>(6)</sup> 0.072         0.021           System Coefficient of Performance         4.7         25.0           Total Campus Sales (trillion Btu)         N/A         0.533           Chilled Water Sources         Mechanical Chillers         83.2%         2%   |  |                                     |                               |
| Total         100%           CHILLED WATER           Energy Output & Input (trillion Btu)         1990         2014           Total Chilled Water Production (trillion Btu)         0.338         0.526           Total Energy Input (trillion Btu) <sup>(6)</sup> 0.072         0.021           System Coefficient of Performance         4.7         25.0           Total Campus Sales (trillion Btu)         N/A         0.533           Chilled Water Sources         Mechanical Chillers         83.2%         2%   |  |                                     |                               |
| CHILLED WATER           Energy Output & Input (trillion Btu)         1990         2014           Total Chilled Water Production (trillion Btu)         0.338         0.526           Total Energy Input (trillion Btu) <sup>(6)</sup> 0.072         0.021           System Coefficient of Performance         4.7         25.0           Total Campus Sales (trillion Btu)         N/A         0.533           Chilled Water Sources         83.2%         2%  |  |                                     |                               |
| Energy Output & Input (trillion Btu)         1990         2014           Total Chilled Water Production (trillion Btu)         0.338         0.526           Total Energy Input (trillion Btu) <sup>(6)</sup> 0.072         0.021           System Coefficient of Performance         4.7         25.0           Total Campus Sales (trillion Btu)         N/A         0.533           Chilled Water Sources         83.2%         2%  |  | 10070                               | 10070                         |
| Total Chilled Water Production (trillion Btu)         0.338         0.526           Total Energy Input (trillion Btu) <sup>(6)</sup> 0.072         0.021           System Coefficient of Performance         4.7         25.0           Total Campus Sales (trillion Btu)         N/A         0.533           Chilled Water Sources         83.2%         2%   | CHILLED WATER  |                                     |                               |
| Total Energy Input (trillion Btu) <sup>(6)</sup> 0.072         0.021           System Coefficient of Performance         4.7         25.0           Total Campus Sales (trillion Btu)         N/A         0.533           Chilled Water Sources         83.2%         2%   |  | 1990                                | 2014                          |
| System Coefficient of Performance         4.7         25.0           Total Campus Sales (trillion Btu)         N/A         0.533           Chilled Water Sources         83.2%         2%  | Energy Output & Input (trillion Btu)   |                                     |                               |
| Total Campus Sales (trillion Btu)  Chilled Water Sources  Mechanical Chillers  N/A  0.533  | Energy Output & Input (trillion Btu)  Total Chilled Water Production (trillion Btu)  | 0.338                               | 0.526                         |
| Chilled Water SourcesMechanical Chillers83.2%2%  | Energy Output & Input (trillion Btu)  Total Chilled Water Production (trillion Btu)  Total Energy Input (trillion Btu) <sup>(6)</sup>  | 0.338<br>0.072                      | 0.526<br>0.021                |
| Mechanical Chillers 83.2% 2%   | Energy Output & Input (trillion Btu)  Total Chilled Water Production (trillion Btu)  Total Energy Input (trillion Btu) <sup>(6)</sup> System Coefficient of Performance  | 0.338<br>0.072<br><b>4.7</b>        | 0.526                         |
| Lake Source Cooling 17% 98%  | Energy Output & Input (trillion Btu)  Total Chilled Water Production (trillion Btu)  Total Energy Input (trillion Btu) <sup>(6)</sup> System Coefficient of Performance  Total Campus Sales (trillion Btu)   | 0.338<br>0.072<br><b>4.7</b>        | 0.526<br>0.021<br><b>25.0</b> |
|  | Energy Output & Input (trillion Btu)  Total Chilled Water Production (trillion Btu)  Total Energy Input (trillion Btu) <sup>(6)</sup> System Coefficient of Performance  Total Campus Sales (trillion Btu)  Chilled Water Sources  Mechanical Chillers | 0.338<br>0.072<br><b>4.7</b><br>N/A | 0.526<br>0.021<br><b>25.0</b> |

| ENERGY RELATED CARBON DIOXIDE (CO <sub>2</sub> ) Purchased Electric               | <u>1990</u> | 201        |
|---|-------------|------------|
| Grid CO <sub>2</sub> Emission Factor (lbs/MWh)                                    | 1,918       | 54         |
| Grid Electric CO <sub>2</sub> (1,000 tons)  | 167         | 1          |
| Cornell Central Energy Plant  |             |            |
| Cornell Coal <sup>(4)</sup>   | 138         |            |
| Cornell Natural Gas <sup>(5)</sup>  | 15          | 16         |
| Cornell Oil<br>Total CEP CO <sub>2</sub> Emissions (1,000 tons)                   | 12<br>165   | 2.<br>16   |
| Total CO <sub>2</sub> Emissions (1,000 tons)                                      | 333         | 17         |
| =   | 333         |            |
| CO <sub>2</sub> Emissions By Primary Energy Type:                                 | 1990        | 201        |
| Electricity (Grid Purchased)  | 50%         | 99         |
| On-Site Coal  | 42%         | 09         |
| On-Site Natural Gas   | 5%          | 909        |
| On-Site Oil   | 4%          | 29         |
| On-Site Hydro   | 0%          | 09         |
| CENTRALLY CONNECTED BLDG GSF x 1,00   | าก          |            |
| OLIVINALET GOMMEGTED BEDG GOT X 1,50  | 1990        | 201        |
| Electric (provided via CEP)   | NA          | 14,00      |
| Steam (provided via CEP)  | NA          | 12,80      |
| Chilled Water (provided via CEP)  | NA          | 8,20       |
| ENERGY METRICS (KBTU/GSF) PER YEAR  |             |            |
|   | 1990        | 201        |
| Electric Sales  | NA          | 5          |
| Steam Sales   | NA          | 11         |
| Chilled Water Sales   | NA          | 6          |
| ENERGY CONSUMPTION BY BUILDING  |             |            |
| Building Type: (trillion Btu)   | 1990        | 201        |
| Research/Teaching   | NA          | 2.1        |
| Campus Life   | NA          | 0.6        |
| Administration  | NA          | 0.2        |
| POPULATION AND WEATHER  |             |            |
|   | <u>1990</u> | <u>201</u> |
| Students  | 18,389      | 20,59      |
| Staff/Non-Faculty   | 7,690       | 9,14       |
| Faculty   | 1,617       | 1,55       |
| thaca Campus <sup>(6)</sup> (1000 GSF)  | 11,800      | 15,80      |
| Campus GSF per Student  | 642         | 76         |
| Heating Degree Days (7,220 Normal)  | 6,919       | 7,77       |
| Cooling Degree Days (337 Normal)  | 312         | 49         |
| GLOSSARY & NOTES  |             |            |
| Btu: British thermal unit   |             |            |
| Primary: Central Plant Usage<br>MMBtu: Million Btu                                |             |            |
| Mwh: mega watt-hour   |             |            |
| (1) Info for CEP only, not all campus facilities pa                               | art of CEP  |            |
| (2) Kyoto Base Year is 1990 (3) Combined Heat & Power Plant start-up EV (         | 2010        |            |
| (3) Combined Heat & Power Plant start-up FY 2<br>(4) "Beyond Coal" begins FY 2012 | 2010        |            |
|   |             |            |

(6) Ithaca Campus GSF includes non-CEP connected facilities