

still gas, petroleum coke, residual fuel oil, wood, and any other material consumed as fuel.

energy performance: an expression of energy use relative to specific building characteristics or other factors that allows potential comparison with other proposed or existing buildings or facilities.

existing building: one that has been in operation and normal use for at least 12 consecutive months following the date of initial occupancy or the date of the certificate of occupancy, or occupancy class change, whichever is later.

energy intensity: an expression of the annual energy used or calculated to be used by a building or building space per unit of gross floor area.

gross floor area: the sum of the floor areas of the spaces within the building, including basements, mezzanine and intermediate-floored tiers, and penthouses with headroom height of 7.50 ft (2.28 m) or greater. It is measured from the exterior faces of exterior walls or from the centerline of walls separating buildings but excludes covered walkways, open roofed-over areas, porches and similar spaces, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, and similar features.

gross conditioned floor area: the gross floor area of a conditioned space.

heating value: the amount of heat produced by the complete combustion of a unit quantity of fuel.

new building: any building in operation for less than 12 consecutive months from the date of initial occupancy or the date of the certificate of occupancy.

net energy: the sum of the purchased energy minus sold or exported energy. Net energy thus takes into account on-site generated electricity that is used in the building and exported from the site.

non-depletable (renewable) energy: forms of energy (excluding minerals) derived from incoming solar radiation, including energy from photosynthetic processes; energy from resulting phenomena including wind, waves, and tides and lake or pond thermal differences; and energy from the internal heat of the earth and nocturnal thermal exchanges.

normalization factors/parameters: factors or parameters that are related to energy use. Dividing energy use by this type of

factor or parameter removes its influence from the energy use and makes the resulting quotient comparable among similar buildings, thereby normalizing for the factor or parameter (e.g., Btu/ft²·yr).

proposed building: any building that is in the design or construction phase.

stored purchased energy: purchased energy forms such as coal or oil that are stored until use.

total energy: the sum of all energy used in the building: purchased energy plus on-site generated electricity minus exported electricity.

4. COMPLIANCE REQUIREMENTS

Compliance with this standard requires compliance with Section 5 as a minimum. Compliance with the requirements of Sections 6 and 7 is optional unless compliance with these sections is reported. Table 4.1 shows the different possible levels of compliance and the requirements for each level. Note that the higher levels of compliance require compliance with all levels below the higher level.

5. BASIC MEASUREMENT AND EXPRESSION OF ENERGY PERFORMANCE

5.1 Compliance with this section requires the reporting of total annual energy, net annual energy, and annual energy costs for a building or building space per unit of gross floor area based upon energy used or expected to be used.

5.2 Basic Building Characteristics. The following basic characteristics must be reported on Form 1.

5.2.1 A building identifier and address, including city, state, country, and zip (mail) code, must be reported on Form 1.

5.2.2 The start and end dates of the data measurement period must be reported on Form 1.

5.2.3 Gross floor area. The total floor area of the building or building space in square feet (square meters) must be reported on Form 1 as gross floor area (see Section 3 for definition).

5.2.4 The number of conditioned floors, with subtotals of above-grade and below-grade floors, must be reported on Form 1.

TABLE 4.1 Possible Levels of Compliance with Standard 105

Level of Compliance	Requirements for Compliance
Basic Measurement and Expression of Energy Performance (Section 5 only)	<ul style="list-style-type: none"> Forms 1 and 2 are completed according to the requirements of Section 5.
Additional Expressions of Energy Performance (Sections 5 and 6)	<ul style="list-style-type: none"> Forms 1 and 2 are completed according to the requirements of Section 5. The requirements of Section 6 are met, including the completion of Form 3.
Comparison of Energy Performance (Sections 5, 6, and 7)	<ul style="list-style-type: none"> Forms 1 and 2 are completed according to the requirements of Section 5. The requirements of Section 6 are met, including the completion of Form 3. The requirements of Section 7 are met, including the completion of Form 4. For documented methods, the analysis report and comparison database used to develop the comparison method are publicly available at no cost to the requester

5.2.5 The primary year of construction must be reported on Form 1. A secondary year of construction to indicate major additions that are less than 50% of total floor area may also be reported.

5.2.6 The basic building type shall be indicated on Form 1, showing the percentage of the gross floor area that is allocated to the various building sub-types or sub-areas shown for the building type. The total of all the percentage values must be greater than 94%. Common spaces, circulation spaces, and other support spaces should be allocated to the type space they serve.

5.3 Energy Consumption. Actual site energy use and energy cost for all types of energy over a period of 12 consecutive months (365 days) shall be reported on Form 2, as set forth below in this section. Appendix A provides methods of measurement for various energy forms. Appendix B provides a method for adjusting to 365 days.

5.3.1 Source of Energy Data. The source of data for each energy form shall be specified in column 2 of Form 2 using the following categories:

- a. Utility bill or meter
- b. Installed meter
- c. Estimate (requires a brief description)
- d. Hourly simulation
- e. Other (requires a brief explanation)

5.3.1.1 Potential estimation methods can be examined in *ASHRAE Guideline 14-2002, Measurement of Energy and Demand Savings* (see Appendix E, Informative Bibliography). Suggested methods for estimation include:

- a. Extrapolate short-term or spot measurements to cover the full operating schedule.
- b. Use deliveries minus energy management system time history of consumption.
- c. Use deliveries and read gauge (oil or propane).
- d. Use deliveries and stick tank (oil).
- e. Use deliveries and subtract carloads (coal or wood).
- f. Use deliveries and estimate size of pile (coal or wood).

5.3.1.2 Simulations should only be used for proposed buildings.

5.3.2 Record the amount of each type of energy used in the 12-month (365-day) period in column 3 and the units of energy in column 4 of Form 2. Each record of energy used should be adjusted to the same 365 day period.

5.3.2.1 Non-Stored Purchased Energy. The amounts of each form of energy purchased through a commercial financial transaction can be measured using the same meter that was used for the financial transaction. If there is not a meter in place, then a commercially acceptable energy meter should be installed to measure energy consumption. If there are energy loads on the meter that are outside the boundary of the building or building space under consideration, then this external energy use should be measured by a separate meter or estimated and subtracted from the energy total on the main meter. All energy amounts should be recorded in the units reported on the energy bill or measured by the installed meter.

5.3.2.2 Stored Purchased Energy. Consumption of energy stored on site shall be measured as the amount of energy purchased minus the net change in inventory during a period of 12 consecutive months. If the annual energy consumption is greater than twice the on-site storage capacity, measurement accuracy need not be reported. If the annual energy consumption is less than twice the on-site storage capacity, measurement accuracy as a percentage of annual consumption and the method of measurement shall be reported. The cost of the stored purchased energy used in the building shall be determined using the cost of the oldest fuel in storage and not its replacement cost.

5.3.2.3 On-Site Renewable Energy Production. Buildings and structures utilizing non-purchased energy produced on-site, such as solar photovoltaic, active solar thermal, wind, hydro and geothermal energy, shall measure the energy delivered to the building through the use of Btu or kWh meters. Energy collected and utilized by passive means such as solar thermal or natural ventilation should not be included. Energy collected and utilized from the environment through air, water, or ground-source heat pump systems should also not be reported.

5.4 Conversion Factors. Record the multiplier to convert the energy amounts to kBtu (kWh) in column 5 of Form 2. Convert all energy forms to the same units, either kBtu or kWh, and record the value in column 6.

5.4.1 The conversion factor used to convert electricity from kWh to kBtu is 3.412 kBtu/kWh.

5.4.2 Heating value conversion factors for fuels shall be obtained from the utility bills or fuel supplier. Heating values of fuel gasses reported on utility bills are typically adjusted for delivered heat content, elevation, and temperature, so additional corrections are usually not needed. If fuel heat content values are not available, users will have to obtain the best available factors. Acceptable values for some fuels are given in Table 5.1. When using values listed in Table 5.1 for gases when the building location has an elevation above 2000 ft (610 m), the heating value should be adjusted for elevation. Appendix C provides informative elevation adjustment calculations. Users should be cautioned that volumetric flow deliveries of liquid fuels are subject to need for temperature correction, but fuel suppliers may not make such corrections. Verification of volumes of liquid fuels delivered is complicated by many factors and, for purposes of this standard, is not required. The values in Table 5.1 for liquid fuels are for a temperature of 60°F (15.6°C). For more information on volume correction for liquid petroleum fuels, users can consult the *Manual of Petroleum Measurement Standards* (API 2004, Chapter 11) for extensive information (see Informative Appendix D, Bibliography).

5.5 Energy Costs. The total cost for each energy form used shall be reported in column 7 of Form 2. Monetary compensation for energy exported (sold) from the facility should be recorded as a negative number.

5.6 Energy and Cost Indices. The total energy, net energy, and energy cost indices shall be reported on Form 2 as indicated.

TABLE 5.1 Higher Heating Values

Coals	Btu/lb		kWh/kg	
Anthracite	12,700		8.2	
Semianthracite	13,600		8.8	
Low-Volatile Bituminous	14,350		9.3	
Medium-Volatile Bituminous	14,000		9.0	
High-Volatile Bituminous A	13,800		8.9	
High-Volatile Bituminous B	12,500		8.1	
High-Volatile Bituminous C	11,000		7.1	
Subbituminous B	9,000		5.8	
Subbituminous C	8,500		5.5	

Fuel Oils	Btu/U.S. gal		kWh/L	
#1	135,000		10.5	
#2	139,000		10.8	
#4	146,000		11.3	
#5L	148,000		11.5	
#5H	150,000		11.6	
#6	154,000		11.9	

Gas				
Natural Gas	1,030 Btu/ft ³		10.7 kWh/m ³	
Propane	91,600 Btu/US gal		7.1 kWh/L	

Bagassee (Moisture Free)	8900 Btu/lb		5.8 kWh/kg	
Sawdust, Peat, Bark	9000 Btu/lb		5.8 kWh/kg	

Woods	Mass lb/cord^a (kg/m³)		Million Btu/Cord^a (kWh/m³)	
	Green^c	Air-Dry^b	Green^c	Air-Dry^b
<i>Species</i>				
Ash	3840 (480)	3440 (430)	16.5 (1300)	20.0 (1600)
Aspen	3440 (430)	2160 (270)	10.3 (800)	12.5 (1000)
Beech, American	4320 (540)	3760 (470)	17.3 (1400)	21.8 (1800)
Birch, yellow	4500 (560)	3680 (460)	17.3 (1400)	21.3 (1700)
Douglas fir	3200 (400)	2400 (300)	13.0 (1100)	18.0 (1500)
Elm, American	4320 (540)	2900 (360)	14.3 (1200)	17.2 (1400)
Hickory, shagbark	5040 (630)	4240 (530)	20.7 (1700)	24.6 (2000)
Maple, red	4000 (500)	3200 (400)	15.0 (1200)	18.6 (1500)
Maple, sugar	4480 (560)	3680 (460)	18.4 (1500)	21.3 (1700)
Oak, red	5120 (640)	3680 (460)	17.9 (1400)	21.3 (1700)
Oak, white	5040 (630)	3920 (490)	19.2 (1600)	22.7 (1800)
Pine, eastern white	2880 (360)	2080 (260)	12.1 (1000)	13.3 (1100)
Pine, eastern yellow	4000 (500)	2600 (330)	14.2 (1100)	20.5 (1700)

^a Based on 80 ft³ of solid wood stacked in a 128 ft³ cord, for a void fraction of 37.5%. Cubic meters apply to the gross volume of a stacked pile of wood with this void fraction.

^b 20% moisture.

^c 40% to 60% moisture.

5.6.1 The total energy is the sum of all energy used in the building. It is equal to the energy imported (purchased) to the facility plus on-site generated energy minus energy exported (sold) from the facility (see Figure 5.1).

5.6.2 The net energy is the sum of the imported (purchased) energy minus exported (sold) energy (see Figure 5.1).

6. ADDITIONAL EXPRESSIONS OF BUILDING ENERGY PERFORMANCE

6.1 This section establishes the requirements for specifying and expressing additional energy performance indices or factors of a building.

6.1.1 Additional expressions of energy performance, such as pounds (kilograms) of annual air emissions per square foot (square meter) of floor area, are optional under this standard unless such expressions are reported. Information on air emissions can be found in Deru and Torcellini (see Informative Appendix D, Bibliography). Although reporting of additional expressions of energy performance is optional, users of the standard may wish to make specific expressions of energy performance requirements for their own use.

6.2 Additional expressions of energy performance must comply with this section to comply with this standard.

6.2.1 Expressions of energy performance that do not use indices, such as a fixed energy use adjustment to total energy use, should still use Form 3 to specify and report the results, although additional notes may be needed to clarify the results.

6.3 The 12-month period for additional expressions of building energy performance shall be the same 12 consecutive months that were used in the calculations for Section 5.6.

6.4 Specification of Comparison or Normalizing Factors. Additional factors for comparing or normalizing energy performance shall be specified on Form 3, either by using the factors listed on the form or by providing names for other factors that are not listed.

6.4.1 For each factor to be used, the type of factor and the value of the factor shall be specified on Form 3.

6.4.2 For each factor to be used, the units of the factor shall be specified on Form 3 if the factor has units. Notes on the factor may also be provided.

6.5 Recommended Factors. All of the factors shown on Form 3 that apply to the building are recommended to be reported by users of this standard, indicating those not applicable as "N/A." Factors that are time dependent, such as degree-days, should be determined for the same 12-month period as used in Section 5.6.

6.6 Additional Expressions of Energy Performance. For each additional numerical expression of energy performance, users shall report the Total Energy use from Form 2, the normalizing factor or characteristic, the normalized expression of energy performance, and the units of normalized expression on Form 3.

7. COMPARISON OF BUILDING ENERGY PERFORMANCE

7.1 This section establishes the requirements for reporting the comparison of a building's energy performance to a performance comparison framework.

7.1.1 The energy and cost indices reported on Form 2 under Section 5.6 shall be the basic, required metrics for comparing building energy performance.

7.1.2 Comparing building energy performance is optional under this standard unless such comparisons are reported, although users of the standard may wish to make specific comparisons of energy performance requirements for their own use.

7.2 Each method of comparing energy performance beyond the energy and cost indices of Section 7.1.1 must conform to the requirements of this section to comply with this standard.

7.3 The 12-month period for each method of comparing annual building energy performance shall be the same 12 consecutive months used in Section 5.6.

7.3.1 For comparison of energy performance over a period other than one year, the time period of the data used to make the comparison shall be specified on Form 4.

7.4 Building Comparison Identification. For the building of interest to be compared to the comparison framework, the building identification data, including building ID and address, comparison period start and end dates, gross floor area, and energy and cost indices from Section 5.3, shall be reported on Form 4.

7.5 Energy Performance Comparison Results. The performance values resulting from each comparison of the building to be compared to a comparison framework shall be reported on Form 4.

7.5.1 For each performance value reported, the type of value, the range of any performance scale, and any units of a performance scale shall be reported on Form 4.

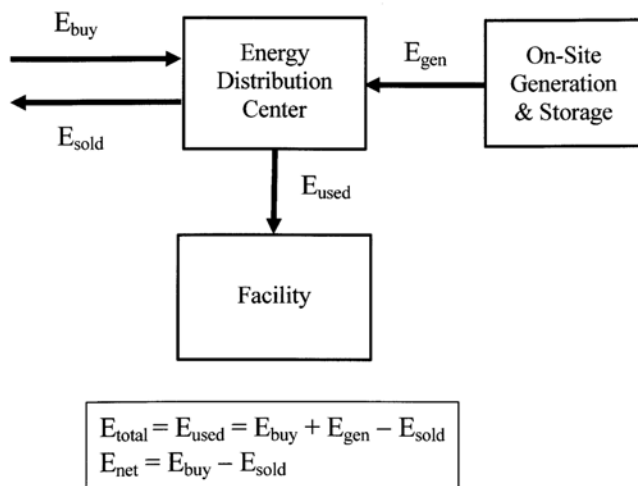


Figure 5.1 Total and net energy flows.