Final Draft 1/15/10

Chapter 11
Energy Efficiency

2009 IRC Chapter 11 has been re-written in its entirety and will serve as Boulder County's energy code for one and two family dwellings and residential accessory buildings with conditioned floor area.

Section N1101 General

N1101.1 Scope and Intent This Chapter 11 implements the provisions of the "Boulder County BuildSmart" program. BuildSmart serves the County's stated goals of promoting and encouraging high performing, sustainable residential development and redevelopment in the unincorporated areas of Boulder County; providing development that will create cost-effective, energy efficient structures that reduce both the production of greenhouse gases from residential buildings and the amount of material sent to landfills; conserving and protecting water and other natural resources in the homebuilding process; insuring proper indoor air quality within energy-efficient residential structures; and insuring a reduction in carbon dioxide emissions from both new and renovated homes by requiring increased energy efficiency. BuildSmart also furthers the goals and measures outlined in the Colorado Climate Action Plan and the County's Sustainable Energy Plan. The production and efficient use of energy will continue to play a central role in the future of Colorado and the nation as a whole. And the development, production, and efficient use of renewable energy will advance the security, economic well-being, and public and environmental health of Colorado, as well as contributing to the energy independence of our nation. The 2010 revision to BuildSmart includes a prescriptive option for compliance, providing builders for whom the performance path option makes less sense with additional flexibility as they select the most cost-effective design for their project.

N1101.2 Requirements for all dwellings in Unincorporated Boulder County. Sections N1101.1 thru Sec N1105.3.4 apply to the conditioned floor area for all one and two family dwellings and accessory buildings, as defined in IRC Sec R202, throughout unincorporated Boulder County. Section N1105.3.5.3 provides a Performance Path Option for compliance. Section N1105.3.5.4 provides a Prescriptive Path Option for compliance.

N1101.3 Compliance Compliance shall be demonstrated by meeting the requirements of this chapter for climate zone 5B.

N1101.3.1 Warm humid counties *This section has been deleted and is non-applicable*

N1101.4 Identification Materials, systems, and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this chapter.

N1101.4.1 Definitions

Addition The placement of or fabrication of a structure that adds floor area to an existing structure. (See definition of floor area in Sec R202).

Certified or Accredited Home Energy Rater A residential energy professional who is certified by the Residential Energy Services Network (RESNET); also referred to as an Energy Rater.

Conditioned Floor Area The floor area of a building that is heated or cooled or that is constructed with rough-in ducts or piping with the intent of it becoming heated or cooled at a future date. This includes: floor area with a fixed opening into heated or cooled space and unfinished basement space. Unenclosed unconditioned covered porches, decks and unconditioned garages are not considered conditioned floor area.

Deconstruction The dismantling of an existing building or portion thereof without the use of heavy machinery or the destruction of the materials. Deconstruction includes the salvage of materials from the existing structure for recycling, resale, or reuse as an alternative to sending them to a landfill. There are two types of deconstruction, structural and non-structural deconstruction.

- **Non-structural deconstruction** (also referred to as soft-stripping) is the removal and reclaiming of the reusable non-structural components such as appliances, cabinets, doors, windows, flooring, fixtures, and finish materials.
- **Structural deconstruction** is the removal and reclaiming of the reusable structural components of a building such as walls, floors, and roofs.

Deconstruction Professional A professional engaged in the deconstruction field.

Demolition The tearing down of an existing structure and the disposal of its components or materials without the implementation of deconstruction techniques.

Energy Efficiency Rating An unbiased indication of a residential building's relative energy efficiency based on consistent inspection procedures, operating assumptions, climate data, and accepted calculation methods.

Energy Rater See Certified or Accredited Home Energy Rater

Floor Area as defined in IRC Sec R202. The area of the building, existing or new, under consideration, including basements and attached garages, calculated without deduction for corridors, stairways, closets, the thickness of interior walls, columns, or other features as measured from the exterior face of the exterior walls.

Gross Wall to Floor Area Ratio The relationship of the total wall area and the total floor area of the conditioned space including the floor area within the inside face of the exterior wall and the wall area measured between the top of the floor and the bottom of the ceiling including window and door openings.

HERS Rating- Home Energy Rating System

Home Energy Rating System A nationally recognized and accepted method of providing a standardized evaluation of a home's energy efficiency and projected energy costs resulting in a rating index based on standardized performance. The Index is established and administered by the Residential Energy Services Network. ("RESNET")

Performance Path Option Construction of conditioned space where compliance is measured using the RESNET system to determine anticipated energy consumption and energy efficiency, (HERS Rating).

Prescriptive Path Option Construction of conditioned space where compliance is achieve by applying minimum standards to the dwellings thermal envelope, fenestration, lighting, and air leakage, (from table N1102.1)

Reconstructed Dwelling A dwelling which has been completely deconstructed, deconstructed to the foundation level, or deconstructed to the first floor level.

Remodel Work within an existing structure which involves work that requires a building permit and involves the removal of the finished interior or exterior wall membrane on more than 25% of the area of the existing exterior wall.

Renewable Energy Systems Renewable energy systems, which meet the intent of the required on-site renewable energy offset, include solar thermal systems, solar photovoltaic electric systems, geo-thermal heating systems, wood and pellet burning stoves, boilers, or furnaces, small scale wind generation systems, and other similar systems.

Renovation Interior work that requires a building permit which does not involve the removal of the finished interior or exterior wall membrane on more than 25% of the area of the existing exterior wall.

N1101.5 Building thermal envelope insulation A R-value identification mark shall be applied by the manufacturer to each piece of building thermal envelope insulation 12 inches or more in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer, and R-value of insulation installed in each element of the building thermal envelope. For blown or sprayed insulation, the initial installed thickness, settled thickness, settled R-value, installed density, coverage area, and number of bags installed shall be listed on the certification. For sprayed polyurethane foam insulation, the installed thickness shall be listed on the certificate. The insulation installer shall sign; date, and mail the or electronically mail the certificate to the Building Division office at the completion of the work.

N1101.5.1 Blown or sprayed roof/ceiling insulation The thickness of blown in or sprayed roof/ceiling insulation shall be written in inches on markers that are installed at least one in each 300 ft. throughout the insulated space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers a minimum of 1 inch high. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed R-value shall be listed on the certificate provided by the Insulation installer.

N1101.5.2 Insulation mark installation Insulating materials shall be installed such that the manufacturer's R-value mark is readily observable upon inspection.

N1101.6 Fenestration product rating U-factors of fenestration products including windows, doors, and skylights shall be determined in accordance with NFRC 100 by an accredited, independent laboratory, and labeled and certified by the manufacturer.

N1101.7 Insulation product rating The thermal resistance (R-value) of insulation shall be determined in accordance with Sec N1105.3.5.3 and Sec N1105.3.5.4.

N1101.8 Installation All materials, systems, and equipment shall be installed in accordance with the manufacturer's installation instructions and the provisions of this code.

N1101.8.1 Protection of exposed foundation insulation Insulation applied to the exterior of basement walls, crawl space walls, and the perimeter of slab-on-grade floors shall have a rigid, opaque, and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The

protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches below grade.

N1101.9 Above code programs *This section has been deleted and is non-applicable.*

N1101.10 Certificate A certificate bearing the address of the residence shall be completed by the installer. The certificate shall list the predominant R-values of the insulation installed in or on the ceiling/roof, walls, foundation, slab, basement slab, crawlspace wall or floor, and ducts outside conditioned spaces, U-factors for fenestration, and the solar heat gain coefficient of fenestration. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall be mailed or electronically mailed to the Building Division at the completion of the work.

Exception: Projects constructed in conformance with the Performance Path Option.

N1101.11 Renewable energy requirements Whenever renewable energy systems are required by this Chapter 11, those systems must be constructed on-site. If an applicant's property is situated in a part of the county where state law permits local utility companies to operate "solar gardens," "solar farms," or similar community renewable energy facilities, the renewable energy requirements of this Chapter 11 may also be satisfied off-site through the purchase of an adequate share in a community facility, at the discretion of the Chief Building Official. At a minimum, an "adequate" share in a community facility must (1) enable the production of an equivalent amount of power compared to what the applicant would otherwise be required to produce on-site; (2) be purchased from a facility located within Boulder County or a county contiguous to Boulder County; and (3) given that such shares do not automatically run with the applicant's land, include a mechanism that ensures the share cannot be sold or modified in any way without the assent of Boulder County with the exception of legal transfer to the applicant's successors-in-interest for use on the same property. Written proof that these requirements are met must be filed with the Building Department before a Certificate of Occupancy will be issued.

Section N1102 Building Thermal Envelope

N1102.1 Insulation and fenestration criteria The building thermal envelope shall meet the requirements of Table N1102.1 or as prescribed by the Energy Rater.

N1102.1.1 R-value computation Insulation materials used in layers, such as framing cavity insulation and insulating sheathing shall be summed to compute the component R-value. The manufacturer's settled R-value shall be used for blown insulation. Computed R-values shall not include an R-value for other building materials or air films.

Exception: Where the energy efficiency is being determined by using the HERS Rating System, the insulation R value shall determined by Energy Rater

N1102.1.2 U-factor alternative An assembly with a U-factor equal to or less than that specified in Table N1102.1.2 shall be permitted as an alternative to the R-value in Table N1102.1.

N1102.1.3 Total UA alternative If the total building thermal envelope UA (sum of U-factor time assembly area) is less than or equal to the total UA resulting from using the U-factors in IRC Table N1102.1.2 (multiplied by the same assembly area as in the proposed building) the building shall be considered in compliance with Table N1102.1. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials. The SHGC requirements shall be met in addition to UA compliance.

N1102.2 Specific insulation requirements

N1102.2.1 Ceilings with attic spaces *This section has been deleted and is non-applicable*

N1102.2.2 Ceilings without attic spaces *This section has been deleted and is non-applicable.*

N1102.2.3 Access hatches and doors Access doors from conditioned spaces to unconditioned spaces shall be weather stripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment, which prevents damaging or compressing the insulation. A wood framed or equivalent baffle or retainer is required to be provided when loose fill insulation is installed, the purpose of which is to prevent the loose fill insulation from spilling into the living space when the attic access is opened and to provide a permanent means of maintaining the installed R-value of the loose fill insulation.

N1102.2.4 Mass walls Mass walls, for the purposes of this chapter, shall be considered above-grade walls of concrete block, concrete, insulated concrete form (ICF), masonry cavity, brick other than brick veneer, earth or compressed or rammed earth, and solid timbers or logs.

N1102.2.5 Steel-frame ceilings, walls, and floors Dwellings constructed with steel-framed ceilings, walls, or floors must be constructed in accordance with Sec N1105.3.5.3 in accordance with the Performance Path Option.

N1102.2.6 Floors Floor insulation shall be installed to maintain permanent contact with the underside of the sub floor decking.

N1102.2.7 Basement walls Exterior walls associated with conditioned basements shall be insulated from the top of the basement wall down to 10 feet below grade or to the basement floor, whichever is less. Exterior basement wall insulation associated with conditioned space must be continuous from the top of the foundation wall to the top of the footing and protected as prescribed in Sec N1101.7.1. Walls associated with unconditioned basements shall meet this requirement unless the floor above is insulated in accordance with Sec N1102.2.6.

N1102.2.8 Slab-on-grade-floors Slab-on-grade floors with a floor surface less than 12 inches below grade shall be insulated in accordance with Table N1102.1. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table N1102.1 by any combination of vertical insulation, or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by a minimum of 10 inches of soil. The top edge of the insulation installed between the exterior wall and the edge of the interior slab shall be permitted to be cut at a 45-degree angle away from the exterior wall. All new concrete slab-on-grade floors within conditioned space must be completely insulated from the ground by foam insulation in conformance with Table N1102.1.

N1102.2.9 Crawlspaces Crawl spaces shall be provided with conditioned air in compliance with Sec N1105.3.5.4.3. Craw space walls shall be insulated in accordance with Table N1102.1 or Table N 1102.21.2. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the floor to the finish grade level and then vertically and/or horizontally for a least an additional 24 inches. Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder with a minimum thickness of 10 mil. All joints of the vapor retarder shall overlap by 6 inches and be sealed and taped. The edges of the vapor retarder shall extend at least 6 inches up the stem wall and shall be attached to the stem wall.

N1102.2.10 Masonry veneer Insulation shall not be required on the horizontal portion of the foundation that supports a masonry veneer.

N1102.2.11 Thermally isolated sunrooms *This section has been deleted and is non-applicable*

N1102.3 Fenestration

N11021.3.1 U-factor An area-weighted average of fenestration products shall be permitted to satisfy the U-factor requirements.

N1102.3.2 Glazed fenestration SHGC *This section has been deleted and is non-applicable*

N1102.3.3 Glazed fenestration exemption *This section has been deleted and is non-applicable*

N1102.3.4 Opaque door exemption One side-hinged opaque door assembly up to 24 square feet in area is exempted from the U-factor requirement in Sec N1101.5(2). This exemption shall not apply to the U-factor alternative approach in Sec N1102.1.2 and the Total UA alternative in Sec N1102.1.3.

N1102.3.5 Thermally isolated sunroom U-factor *This section has been deleted and is non*-applicable.

N1102.3.6 Replacement fenestration Where some or all of the existing fenestration unit is replaced with a new fenestration product, including sash and glazing, the replacement fenestration unit shall meet the applicable requirements for U-factor in Table N1102.1.

N1102.4 Air leakage

N1102.4.1 Building thermal envelope The building thermal envelope shall be durably sealed to limit infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weather-stripped, or otherwise sealed with an air barrier material, suitable film, or solid material.

1. All joints, seams, and penetrations.
2. Site-built windows, doors, and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating the garage from conditioned space.
8. Behind tubs and showers on exterior walls.
9. Common walls between dwelling units.
10. Attic access openings.
11. Rim joists junction.
12. Other sources of infiltration.

N1102.4.2 Air sealing and insulation Building envelope air tightness and insulation installation shall shall be done in compliance with Sec N1102.4.2.1.

N1102.4.2.1 Testing Tested air leakage is less than 5 ACH when tested with a blower door at a pressure of 50 Pascals (7ACH at 50 Pa for additions and remodels). Testing shall occur after rough in and after installation of penetrations of the Building envelope, including penetrations for utilities, plumbing, electrical, ventilation, and combustion appliances.

During testing:

1. Exterior windows and doors, fireplace, and stove doors shall be closed, but not sealed.
2. Dampers shall be closed, but not sealed including exhaust, intake, makeup air, back draft, and flue dampers.
3. Interior doors shall be open.
4. Exterior openings for continuous ventilation systems and heat recovery ventilators shall be closed and sealed.
5. Heating and cooling systems(s) shall be turned off.
6. HVAC ducts shall not be sealed.
7. Supply and return registers shall not be sealed.

N1102.4.3 Fireplaces *This section has been deleted and is non-applicable.*

N1102.4.4 Fenestration air leakage Windows, skylights, and sliding glass doors shall have an air infiltration rate of no more than 0.3 cubic foot per minute per square foot, and swinging doors no more than

0.5 cubic foot per minute per square foot when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory, and listed and labeled by the manufacturer.

Exception: Site-built widows, skylights, and doors that serve unconditioned space

N1102.4.5 Recessed Lighting Recessed luminaries installed in the building thermal envelope shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaries shall be IC-rated and labeled as meeting ASTM E 283 when tested a 1.57 psi pressure differential with not more than 2.0 cfm of air movement from the conditioned space to the ceiling cavity. All recessed luminaries shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

Section N1103 Systems

N1103.1 Controls At least one thermostat shall be installed for each separate heating and cooling system.

N1103.1.1 Programmable thermostat Where the primary heating system is a forced air furnace, at least one thermostat per dwelling unit shall be capable of controlling the heating and cooling system on a daily schedule to maintain different temperature set points at different times of the day. This thermostat shall include the capability to set back or temporarily operate the system to maintain zone temperatures down to 55 degrees F or up to 85 degrees F. The thermostat shall initially be programmed with a heating temperature set point no higher than 70 degrees F and a cooling temperature set point no lower than 78 degrees F.

N1103.1.2 Heat pump supplementary heat Heat pumps having supplementary electric-resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

N1103.1.3 Equipment design New equipment installed for heating, cooling, or ventilation must be designed and sized based on building loads in accordance with ACCA Manual J or other approved software or methodologies. Calculations must be provided to the Building Division prior to scheduling the rough inspection.

Exception: Submittal of calculations is not required. for permits issued only for the replacement of existing equipment in existing dwellings

N1103.2 Ducts New ductwork installed in new dwellings, additions, and existing dwellings shall be located inside the buildings thermal envelope unless structural or design conditions make this type of installation impossible.

N1103.2.1 Insulation Supply ducts in attics shall be insulated to a minimum of R-8. All other ducts shall be insulated to a minimum of R-6.

N1103.2.1.1 Duct design New duct systems serving heating, cooling, and ventilation equipment shall be designed in accordance with ACCA Manual D or other approved software. Design calculations must be provided to the Building Division prior to scheduling the rough inspections.

Exception: Submittal of calculations for ductwork is not required for existing ductwork or for existing ductwork serving replacement appliances.

N1103.2.2 Sealing Ducts Air handlers, and filter boxes, shall be sealed. Joints and seams shall comply with IRC Sec M1601.4. Framed building cavities shall not be used as ducts. Duct tightness shall be verified by:

1. Post-construction test: Leakage to outdoors shall be less than or equal to 8 cubic feet per minute (cfm) per 100 square feet of conditioned floor area or a total leakage less than or equal to 12 cfm of conditioned floor area when tested at a pressure differential of 0.1 inch w. g.(25 Pascals) across the entire system, including the manufacturer's air handler end closure. All register boots shall be taped or otherwise sealed during the test. If the air Handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm of conditioned floor area.

2. Rough-in test: Total leakage shall be less than or equal to 6 cfm per 100 $ft.^2$ of conditioned floor

area when tested at a pressure differential of 0.1 inch w.g. (25 Pascals) across the roughed in system, including the manufacturer's air handler enclosure. All register boots shall be taped or otherwise sealed during the test. If the air handler is not installed at the time of the test, total leakage shall be less than or equal to 4 cfm per 100 ft^2 of conditioned floor area.

N1103.2.3 Building Cavities Building framing cavities shall not be used as supply or return ducts.

N1103.3 Mechanical system piping insulation Mechanical system piping capable of carrying fluids above 105 degrees F or below 55 degrees F shall be insulated to a minimum of R-3.

N1103.4 Circulating hot water systems All circulating service hot water piping shall be insulated to at least R-2. Circulating hot water systems shall include an automatic or readily accessible manual switch that can turn off the hot water circulating pump when the system is not in use.

N1103.5 Mechanical ventilation Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

N1103.5.1 Minimum required ventilation In addition to and in lieu of the requirements of IRC Sec R303.1, all residences must be provided with mechanical ventilation. All habitable rooms must be supplied with a mechanical ventilation system capable that produces an air flow in conformance with Table N1103.5.1.

Table N1103.5.1
Ventilation Air Requirements in Cubic Feet Per Minute

Floor Area (square feet)	Bedrooms				
	0-1	2-3	4-5	6-7	>7
< 1,500	30	45	60	75	90
1,501-3.000	45	60	75	90	105
3,001-4,500	60	75	90	105	120
4,501-6,000	75	90	105	120	150
6,001-7,500	90	105	120	135	150
>7,500	105	120	135	150	165

For SI: 1 square foot = 1 square foot=0.0929 m2.

Alternative Method of Calculating Ventilation Air Requirements

Qfan=0.01 Afloor=7.5(Nbr=1)

Where:

Qfan=fan flow rate in cubic feet per minute (cfm).

Afloor=floor area in square feet (ft2)

Nbr = number of bedrooms; not to be less than

N1103.6 Equipment sizing Heating and cooling equipment shall be sized as specified in IRC Sec M1401.3

N1103.7 Snow melt systems

N1103.7.1 Controls Snow and ice melting systems supplied through energy service to the building shall include automatic controls capable of shutting off the system when the pavement temperature is above 50 degrees F and no precipitation is falling and an automatic or manual control that will allow shutoff when the outdoor temperature is above 40 degrees F.

N1103.7.2 Design Energy use by snow and ice melt systems must be offset by on-site renewable energy generation equivalent to the energy used by the snow and ice melting equipment. Plans must be submitted

that detail the type, size and location of the on-site renewable energy generation equipment. **Note**: A separate building permit is required for on-site renewable energy generation equipment.

N1103.7.2.1 Design criteria for supporting on-site renewable energy equipment On-site renewable energy generation equipment installed to offset the energy used by snow and ice melt systems must be designed to provide 34,425 BTUs per square foot per year.

N1103.8 Swimming Pools Swimming pools must be provided with energy conservation measures in accordance with Sec N1103.8.1 through N1103.8.6, or be unheated. Heated pools must be heated by solar thermal or other equipment that does not rely directly or indirectly on the burning of fossil fuels or they must have their energy use offset by on-site renewable energy generation equipment equivalent to the energy use by the swimming pool. The energy use shall be determined per Sec N1103.8.6.

Exception: Swimming pools less than 200 sq. ft. in area are exempt from the requirements to provide renewable energy.

N1103.8.1 Pool heaters All pool heaters shall be equipped with a readily accessible on-off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fire by natural gas or LPG shall no have continuously burning pilot lights.

N1103.8.2 Time switches Time switches that can automatically turn off and on heaters and pumps according to a preset schedule shall be installed on swimming pool heaters and pumps.

Exception: Where pumps are required to operate solar and waste heat recovery pool heating systems.

N1103.8.3 Pool Covers Heated pools shall be equipped with a vapor retardant pool cover on or at the water surface. Pools heated to more than 90 degrees F shall have a pool cover with a minimum insulation value of R-12.

N1103.8.4 Filters Swimming pool filters must be cartridge-type filters.

N1103.8.5 Pumps Swimming pool pumps must be multi-speed pumps.

N1103.8.6 Energy conservation design standards for swimming pools For the purpose of determining and measuring the energy use of swimming pools in unincorporated Boulder County, the following are assumed. ***Note:*** *This section is not intended to limit the season or temperature of swimming pools.*

Swimming pool season
Outdoor pools 3 months
Indoor pools 12 months

Pool heating Temperature 82 degrees F or less.

On-site renewable energy requirements
29,000 BTUs per square foot per year.

N1103.9 Spas Any energy use by spas must be offset by on-site renewable energy generation equivalent to the energy use by the spa. Plans must show the annual energy use of the spa, the calculation method used to

determine the expected energy use, and the on-site renewable energy system(s) which will be used to offset the energy used by the spa. All spas must be equipped with an insulated cover that is listed to provide a minimum R-value of at least R12.

Exception: New Spas and hot tubs which have been tested and listed for compliance with the requirements of the California Energy Commission (CEC) title 20 (Standby power for portable electric spas shall not be greater than 5[V2/3] watts where V=the total volume of the spa in gallons), and are less than 64 sq ft in surface area shall be exempted from the requirement to offset their energy usage by on-site renewable energy generation. Spas larger than 64 sq. ft. in surface are that are certified to meet the requirements of the CEC shall offset their requirements at the rate of 140,000 BTUs per sq ft per year.

N1103.9.1 Design criteria for spas The requirements of this section apply to spas that meet other standards than those in sec N1103.9.

Season 12 months
On-site renewable energy requirements 430,000 BTUs per square foot per year.

Section N1104 Lighting Systems

N1104.1 A minimum of 80 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps.

Section N1105 Sustainability

N1105.1 Applicability This Chapter applies to new one and two family dwellings and residential accessory buildings as defined in IRC Sec R202 and all related residential construction work that requires a building permit including: renovated dwellings, remodeled dwellings, moved dwellings, additions to existing dwellings, and combined additions remodels and renovations.

Exception: Federally-certified manufactured dwellings and state-certified factory-built dwellings.

N1105.2 Required Elements

N1105.2.1 Deconstruction All existing buildings and portions thereof must be deconstructed as defined in Section N1101.3.1. Demolition is not permitted.

N1105.2.1.1 Penalty Buildings that are demolished or partially demolished rather than deconstructed will, at the discretion of the Building Official, be issued a Stop Work notice for a period not exceeding 30 days.

N1105.2.1.2 Documentation of Intent to Deconstruct Documentation of intent to deconstruct consisting of a deconstruction plan, a written description of deconstruction work, or the County Deconstruction Checklist must be provided at building permit application. The documentation of intent to deconstruct must include: the name of the Deconstruction Contractor, a list of the materials to be recovered, donated, or reused, and the destination of the materials. The documentation must include both Nonstructural Deconstruction and Structural Deconstruction. Items which must be donated, sold, or re-used include: cabinets, dimensional lumber, flooring, and solid core doors.

N1105.2.1.3 Verification of deconstruction of a structure The completion of the deconstruction as approved on the deconstruction plan must be verified by the Building Division. The owner or deconstruction contractor shall provide written verification of deconstruction by means of receipts or a written log, maintained by the homeowner or general contractor, which includes the volume or weight of materials and the destination where they were transported to the Building Division office. Verification must be received prior to scheduling the rough inspections.

N1105.2.2 Construction Jobsite Waste Reduction and Recycling All construction jobsite waste must be recycled including wood, scrap metal, cardboard, and concrete. Labeled containers must be provided at the construction site for use in capturing recyclable material. A mixed load container may be used if that container is being sent to a waste/recycling center that will verify the weight of recycled material recovered from that mixed load.

N1105.2.2.1 Documentation of Intent to Recycle Documentation of intent to recycle which consists of a recycling plan, a written description of recycling activity, or the submittal of the County Recycling Checklist must be provided at building permit application. The documentation must clearly show how the requirements of Sec 1105.3.2 will be met and must specify the locations of recycling containers and the destination where material will be recycled.

N1105.2.2.2. Verification Field inspection will be made by the Boulder County Building Division during the construction process to assure that recycling containers have been placed on site. Prior to the final inspection, documentation must be provided to the Building Division office by the owner or

waste/recycling contractor indicating the weight or volume of materials diverted from the waste stream. Materials that must be recycled include: appliances, concrete, metals, cardboard, and wood (except pressure treated or painted wood), and thermostats containing mercury. Other materials which are accepted by the waste/recycling contractor must also be recycled.

N1105.2.3. Interior water conservation

N1105.2.3.1 Requirements The following new and replacement plumbing fixtures must be labeled as meeting EPA Water Sense (http://www.epa.gov/WaterSense/) criteria: Bathroom sink faucets, shower heads, toilets, and urinals.

Exception: Showerheads with a maximum flow of 2.0 gpm, urinals with a flush rate of .5 gallons per flush.

N1105.2.4 Indoor air quality

N1105.2.4.1 Attached garages Doors between attached garages and living space shall be weather stripped to the degree necessary to make them airtight and shall be self-closing and self-latching.

N1105.2.5 Energy Conservation The provisions of this section applies to portions of one and two family dwellings and accessory buildings with conditioned floor area as defined in IRC Sec R202. Dwellings and accessory buildings with new, remodeled, or renovated conditioned floor area as defined in Sec N1101.3.1 shall be constructed in accordance with the Performance Path Option in Sec N1105.3.5.3 or in accordance with the Prescriptive Path Option in Sec N1105.3.5.4.

Exception: Federally-certified manufactured dwellings and state-certified factory-built dwellings.

N1105.2.5.1 Construction Conditioned floor area within new dwellings, additions to dwellings, remodeled dwellings, and accessory buildings that contain conditioned space shall be constructed in accordance with for the Performance Path Option in Sec N1105.4.3.5.3 or in accordance with the Prescriptive Path Option in Sec N1105.3.5.4 for.

N1105.2.5.2 Calculation of energy usage for projects using the Performance Path Option Energy conservation requirements of this section will be calculated by using the HERS Index applicable on the date of the adoption of this Chapter.

Exception: Dwellings constructed in accordance with the Prescriptive Path in Sec N1105.3.5.3.

N1105.2.5.3 Performance Path Option requirements The provisions of this section apply to the the conditioned floor area of all new one and two family dwellings, additions of conditioned floor area to one and two family dwellings, and remodels of the conditioned floor area of one and two family dwellings unless the design and construction complies with the Prescriptive Path Option of Sec N1105.3.5.4.

N1105.2.5.3.1 New dwellings and reconstructed dwellings The requirements of this subsection applies to the conditioned floor area of new dwellings and reconstructed dwellings constructed in accordance with the Performance Path Option. New dwellings and reconstructed dwellings must meet the HERS Index Rating shown on Table 1. A RESNET model prepared by an Energy Rater must be

provided with the building permit application showing compliance with the required HERS Index rating.

N1105.2.5.3.2 Performance Path Option requirements for additions to existing dwellings The requirements of this subsection apply to the total combined conditioned floor area of existing dwellings and the new conditioned floor area of additions. The method of calculating the HERS rating requirement will be determined by using Figure 1. The combined new and existing conditioned floor area must comply with Table 1 or Table 2 as indicated by Figure 1. A RESNET model prepared by an Energy Rater must be provided with the building permit application showing compliance with the required HERS Index rating.

N1105.2.5.3.3 Performance Path Option requirements for remodels Remodels of conditioned interior spaces including basement spaces must meet the requirements of this subsection unless constructed in accordance with the Prescriptive Path Option in Sec N1105.3.5.4. A RESNET model prepared by an Energy Rater must be provided with the building permit application showing that the entire dwelling can achieve a HERS rating of at least 80.

N1105.2.5.3.4 Performance path option requirements for basement finishes Basement finishes *(the finishing of previously unfinished conditioned basement space)* must meet the requirements of this subsection unless constructed in accordance with the Prescriptive Path Option in Sec N1105.3.5.4. A RESNET model prepared by an Energy Rater must be provided with the building permit application which demonstrates that the total conditioned floor area of the dwelling has achieved a HERS rating of 80.

N1105.2.5.3.5 Performance Path Option requirements for accessory buildings Detached accessory structures as defined in IRC Sec R202 that contain conditioned space that are constructed in accordance with the Performance Path Option must meet the HERS Rating shown on Table 1. As an alternative, an acceptable analysis may be presented by an Energy Rater which demonstrate that the building design achieves the applicable percent above current code. The RESNET energy model or analysis must be provided with the building permit application.

N1105.2.5.3.6 Inspection requirements for projects constructed under the Performance Path Option.

N1105.2.5.3.6.1 During construction An Energy Rater must perform a pre-drywall inspection including a duct blaster test (if applicable) to ensure the ability of the residence to achieve the required HERS Index rating. **Prior to the installation of the wall or ceiling finish materials** the owner or contractor must submit verification of the Energy Rater's inspection to the Building Division office which demonstrates that the building has been constructed in conformance with the RESNET model.

N1105.2.5.3.6.2. Upon completion of construction and prior to final building inspection approval or (if applicable) **approval of a Certificate of Occupancy** an Energy Rater must perform a final inspection which includes a blower door test and submit documentation to the Building Division office verifying that the residence meets the applicable HERS Index rating, (final HERS certificate).

N1105.2.5.4 Prescriptive Path Option requirements As an alternative to compliance with the

Performance Path Option requirements in Sec N1105.3.5.3, the conditioned floor area of new dwellings, additions, remodels, and renovations as well as combinations thereof may be constructed in accordance with the Prescriptive Path Option. Dwellings constructed in compliance with the Prescriptive Path Option must conform to Tables N1102.1, N1102.1.2, N1102.1.3 and as applicable Table 3 and 4.

Exception:

1. New dwellings with conditioned floor area exceeding of 6,000 sq. ft. or greater must be constructed in accordance with the Performance Path Option in Sec N1105.3.5.3.
2. Additions where the combined new and existing conditioned floor area exceeds 6000 sq ft must be constructed in accordance with the Performance Path Option in Sec N1105.3.5.3.

N1105.2.5.4.1 Prescriptive Path Option required elements Buildings designed and constructed to meet the Prescriptive Path requirements must conform to the values in Table N1102.1 and Table N1102.1.3 or Table N1102.1.2 and Table N1102.1.3. Dwellings with conditioned floor area in excess of 3,000 sq. ft. must also comply with Tables 3 or 4.

N1105.2.5.4.2 Garages constructed using the Prescriptive Path Garages and shops that contain conditioned floor area that are equipped with overhead doors must have fully-weather stripped overhead doors with a minimum R value of R13. Overhead doors must be weather stripped at the top, sides, bottom, and between the panels.

N1105.2.5.4.3 Requirements for the existing portions of dwellings for additions and remodels constructed using the Prescriptive Path Option. Existing portions of dwellings must be upgraded with the following elements:

1. The existing dwelling must achieve a maximum air leakage of 7 air changes per hour measured at 50 pascals
2. The insulation in the existing attic must be upgraded to an R-value of R38. Vaulted or cathedral ceiling cavities must be filled with insulation.
3. 50% of existing lighting fixtures must be equipped with compact fluorescent lights.
4. Crawlspace walls must be insulated in compliance with Table N1102.1 or Table N1102.1.2.
    - A Class 1 vapor retarder shall be placed on the crawlspace grade with joints sealed and overlapped a minimum of 6 inches and edges extending at least 6 inches on to the stem wall and sealed.
    - The crawlspace must be provided with continuously-operated mechanical exhaust ventilation at a rate of 1 cu. ft./minute for each 50 sq. ft. of crawlspace floor area including an air pathway to the common area such as a duct or transfer grill. *(see IRC Sec R408)* As an alternative to the continuously operated mechanical exhaust ventilation, a conditioned air supply of at least 1 cu. ft./minute for each 50 sq. ft. of crawlspace area and a return air pathway to the common area may be provided. *(see IRC Sec R408)*

Exception:

The following projects are not required to comply with requirements 1-4 of Sec N1105.3.5.4.3.:

- Window replacements.
- Bathroom remodels limited to the replacement of fixtures and cabinets.
- Kitchen remodels limited to the replacement of cabinets, counter tops, plumbing fixtures, and appliances.

- Additions, remodels, and renovations as defined in Sec N1101.3.1 of less than 200 square feet.

N1105.2.5.4.4 Inspection requirements for projects constructed under the Prescriptive Path Option.

During construction

1. An Energy Rater must perform an insulation inspection. Insulation must meet RESNET Grade 1 Standard.
2. An Energy Rater must perform a duct blaster test (when applicable). Duct leakage must not exceed 8 cfm per 100 sq. ft. of conditioned floor area or a total leakage less than or equal to 12 cfm of conditioned floor area when tested at a pressure differential of 0.1 inch w. g. across the entire system, including the manufacturer's air handler enclosure.

Upon completion of construction and prior to final building inspection approval an Energy Rater must perform a blower door test and submit documentation to the Building Division office verifying that air leakage does not exceed 5 air changes per hour at 50 pascals of pressure.

Exception: Air leakage not exceeding 7 air changes per hour at 50 PA of pressure is permitted for additions and remodels.

Table N1102.1

INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT									
Fenestration U-Factor	Skylight U-Factor	Ceiling R-Value	Wood Frame Wall R-Value	Mass Wall R-Value[a]	Floor R-Value	Basement[b] Wall R-Value	Slab[c] Edge R-Value and Depth	Crawl Space[b] Wall R-Value	Underslab R-Value
0.35	0.45	54	19+10[d]	18/24	42	15/20	15, 3ft	15/20	10

Table N1102.1.2

EQUIVALENT U-FACTORS							
Ceiling U-Factor	Wood Frame Wall U-Factor	Mass Wall U-Factor[e]	Floor U-Factor	Basement Wall U-Factor	Slab U-Factor and Depth	Crawl Space Wall U-Factor	Underslab U-Factor
0.020	0.039	0.056	0.026	0.067/0.05	0.067, 3ft	0.067	0.10

Note: R-Values are minimums. U-factors and solar heat gain coefficients (SHGC) are maximums. R-19 batts compressed in to nominal 2x6 framing cavity such that the R-value is reduced by R-1 or more shall be marked with the compressed batt R-value in addition to the full thickness R-value.

a. The second R-value applies when more than half the insulation is on the interior.
b. The first R-value applies to continuous insulation, the second to framing cavity insulation; either insulation meets the requirement.
c. R-5 shall be added to the required slab edge R-values for heated slabs.
d. "19+10" means R-19 cavity insulation plus R-10 insulated sheathing. If structural sheathing covers 25% or less of the exterior, R-10 sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of exterior, structural sheathing shall be supplemented with insulated sheathing of at least R-5
e. When more than half the insulation is on the interior, the mass wall U-factor shall be the same as the frame wall U-factor

Table N1102.1.3

ADDITIONAL REQUIREMENTS						
Maximum Glazing to Floor Area Ratio	Maximum Air Leakage 3	Appliances (New or Replaced)	Lighting Fixtures	Insulation Installation Standards	Furnaces And Boilers 1,2	Water Heaters 1,2
18%	5 ACH at 50 Pascals	Energy Star Certified	80% CFL or equal	RESNET grade 1 standards	92%AFUE With ECM Blower Motors	82 EF

1. Permits issued for the replacement of existing furnaces, boilers, and water heaters are exempt from these requirements.
2. For projects involving additions and remodels furnace and water heaters only need to meet these requirements if they are replaced.
3. 7ACH at 50 Pascals for additions and remodels

N1105.2.5.5 Relocated buildings Dwellings which have been moved to a new location on a parcel or dwellings which have been moved from one parcel to another must comply with the requirements of this section.

New construction New construction associated with the relocation of the building must conform to requirements of the Performance Path Option in Sec N1105.3.5.3 and achieve a HERS rating of at least 80 for the entire building, or be constructed in accordance with the Prescriptive Path Option in Sec N1105.3.5.4.

Existing Building The existing portions of the relocated building must conform to the requirements of Sec N1105.3.5.4.3 for Requirements for the Existing Portions of Dwellings for Additions and Remodels

N1105.2.5.6 Renovations Renovations of existing portions of dwellings as defied in Sec. N1101.3.1. must comply with the Energy Efficiency Requirements for Exiting Portions of Dwellings in Sec N1105.3.5.4.3

Exception:

- Electrical work associated with permits issued only for electrical work
- Plumbing associated with permits issued only for plumbing.
- Replacement HVAC appliances associated with permits issued only for appliance replacement.
- Window replacements.
- Bathroom remodels limited to the replacement of fixtures and cabinets.
- Kitchen remodels limited to the replacement of cabinets, counter tops, plumbing fixtures, and appliances.
- Additions, remodels, and renovations as defined in Sec N1101.3.1 of less than 200 square feet.

N1105.3 Modifications The Chief Building Official may make modifications to the requirements of this Chapter as allowed in Sec 104.10 of the Boulder County Building Code if it is determined that strict application of the requirements of this Chapter:

1. Creates practical difficulties or excessive expense in the upgrade of an existing residential structure so that the residence can meet the mandatory HERS Index or Prescriptive requirements.
2. Requires and alteration to either a structure greater than 50 years in age or any structure in a historic district or site which would materially alter the historic integrity of that structure or adversely effect the historic integrity of the historic district or site.
3. Creates practical difficulties in meeting on-site renewable energy requirements due to topographic constraints associated with the lot or location of the structure.

In assessing whether a request for a modification should be granted, the Chief Building Official shall, in consultation with the staff and/or an Energy Rater retained by the Building Official at the applicant's expense, determine whether the strict application of this Chapter creates a situation described in items 1 through 3 listed immediately above. If it is determined that the request warrants a modification on this basis the Chief Building Official shall determine what appropriate mitigation measures shall be required to ensure that the structure meets the intent and spirit of this Chapter. Appropriate mitigation measures may include requiring additional energy-saving or resource-efficient construction methods or materials, sustainable framing techniques, use of environmentally friendly materials, adoption of water-saving landscaping and irrigation, and similar conservation measures.

FIGURE 1

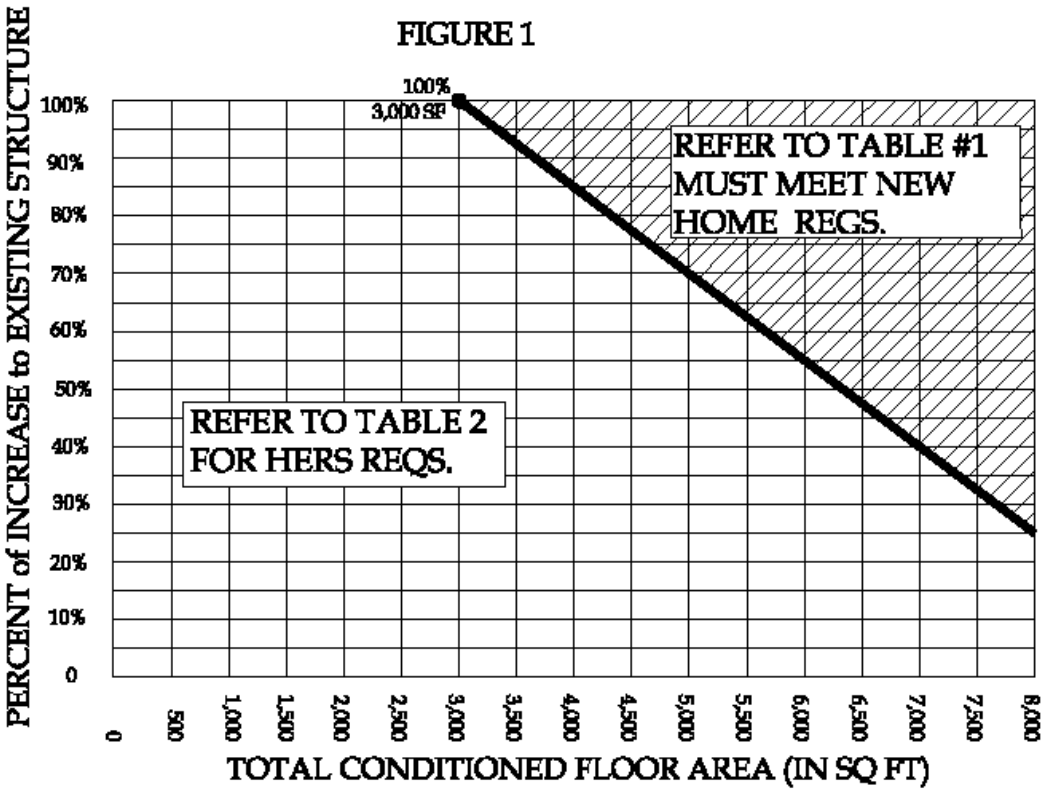

PERCENT of INCREASE to EXISTING STRUCTURE
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0
100%
3,000 SF
REFER TO TABLE #1
MUST MEET NEW
HOME REGS.
REFER TO TABLE 2
FOR HERS REQS.
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
7,000
7,500
8,000
TOTAL CONDITIONED FLOOR AREA (IN SQ FT)

TABLE 1 - NEW CONSTRUCTION

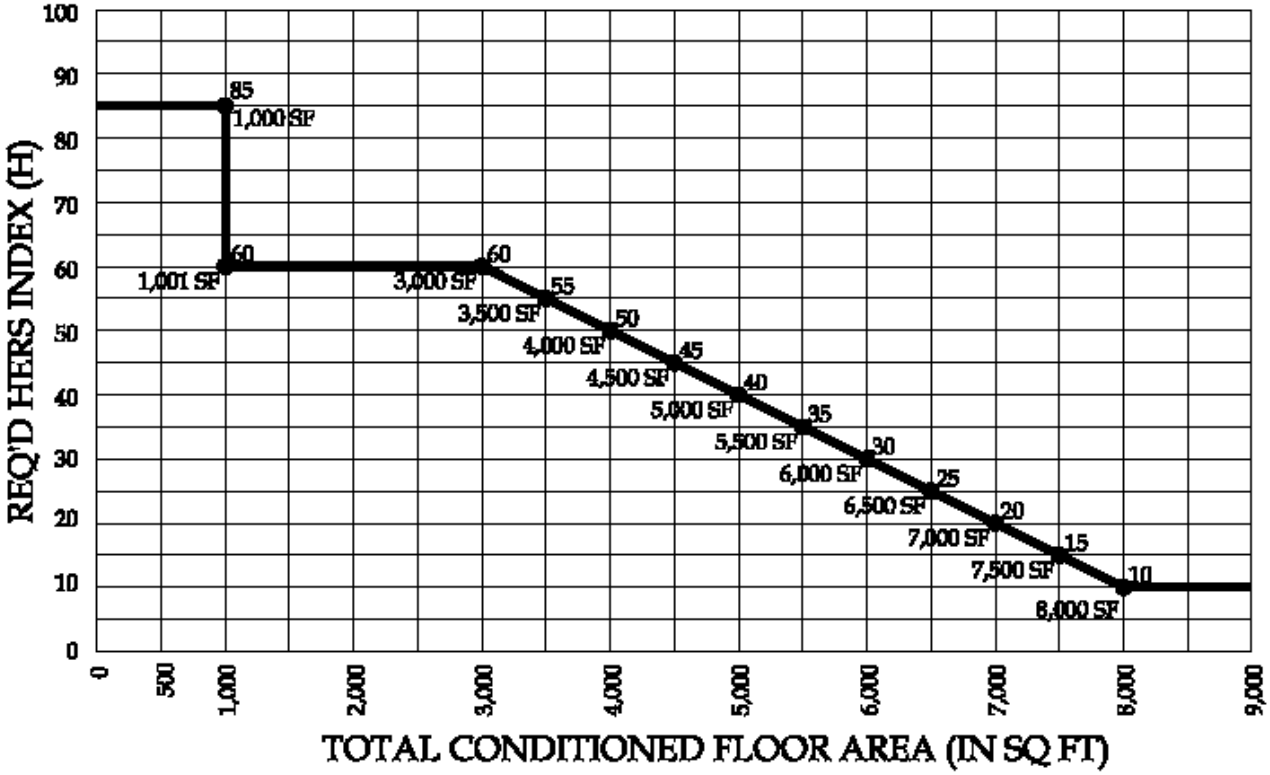


Table 2 HERS Rating Requirements for Additions

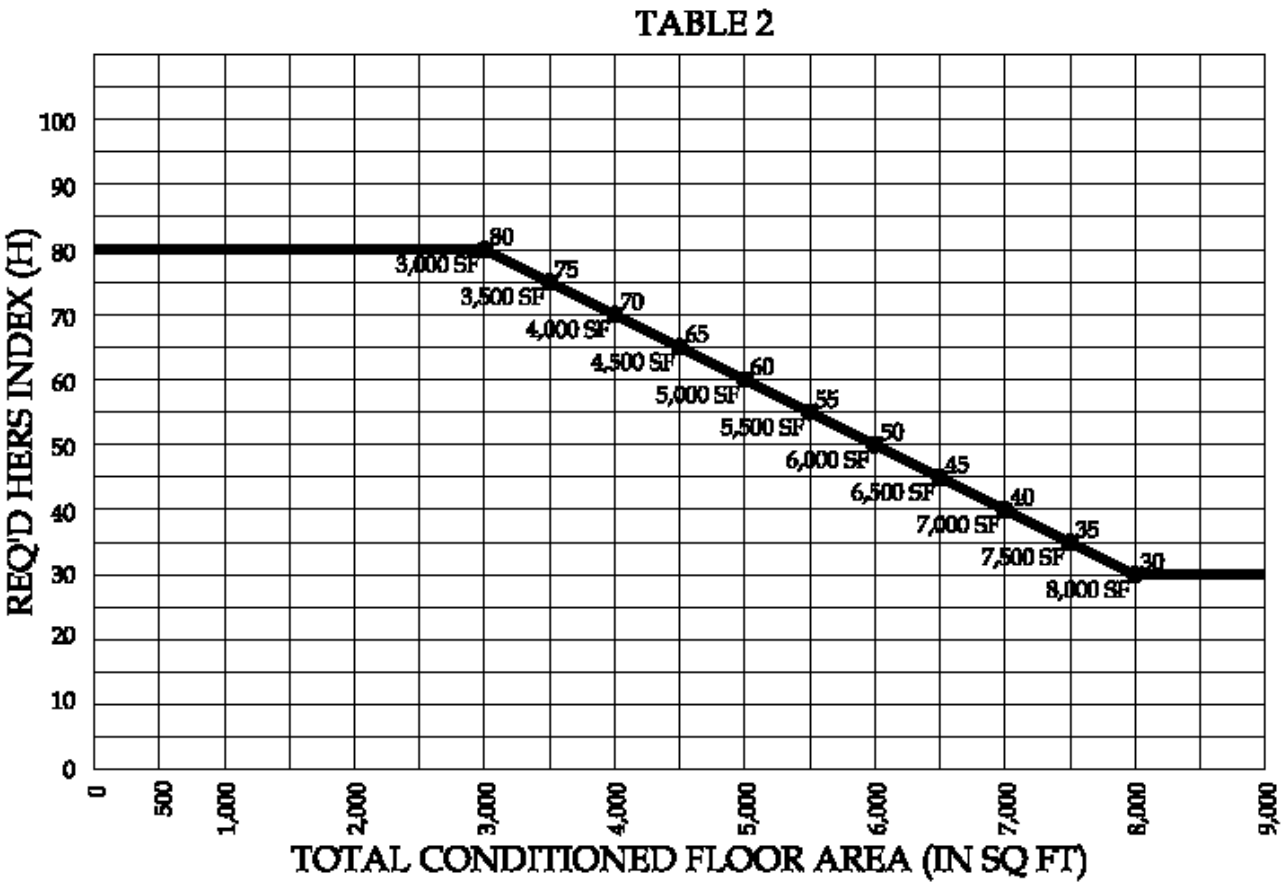
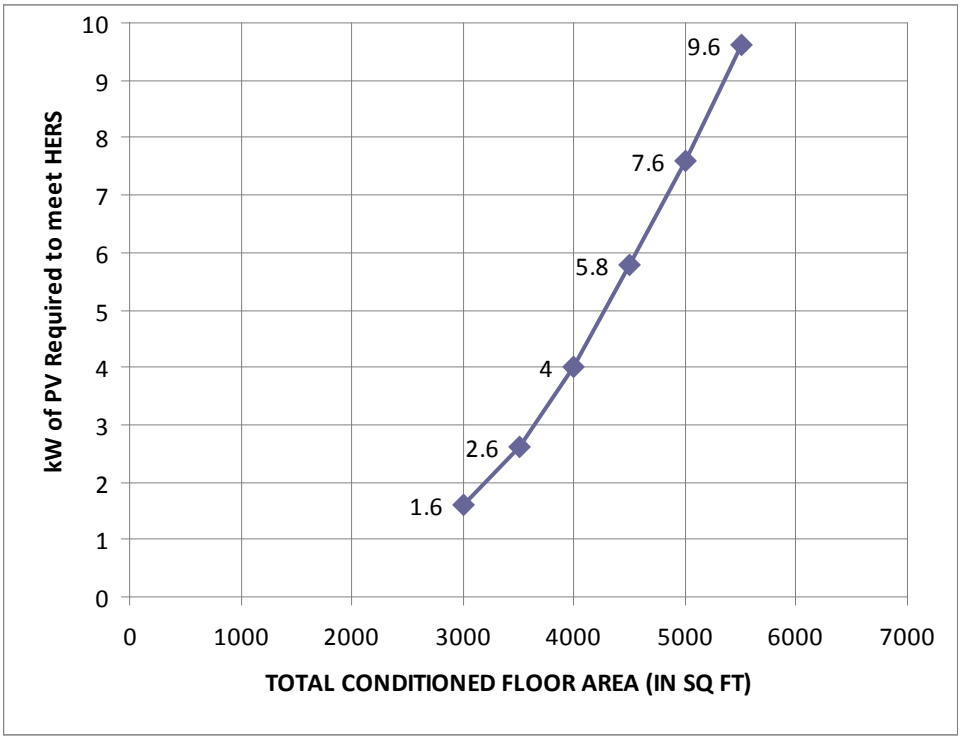


Table 3
PV Requirements for New Residences

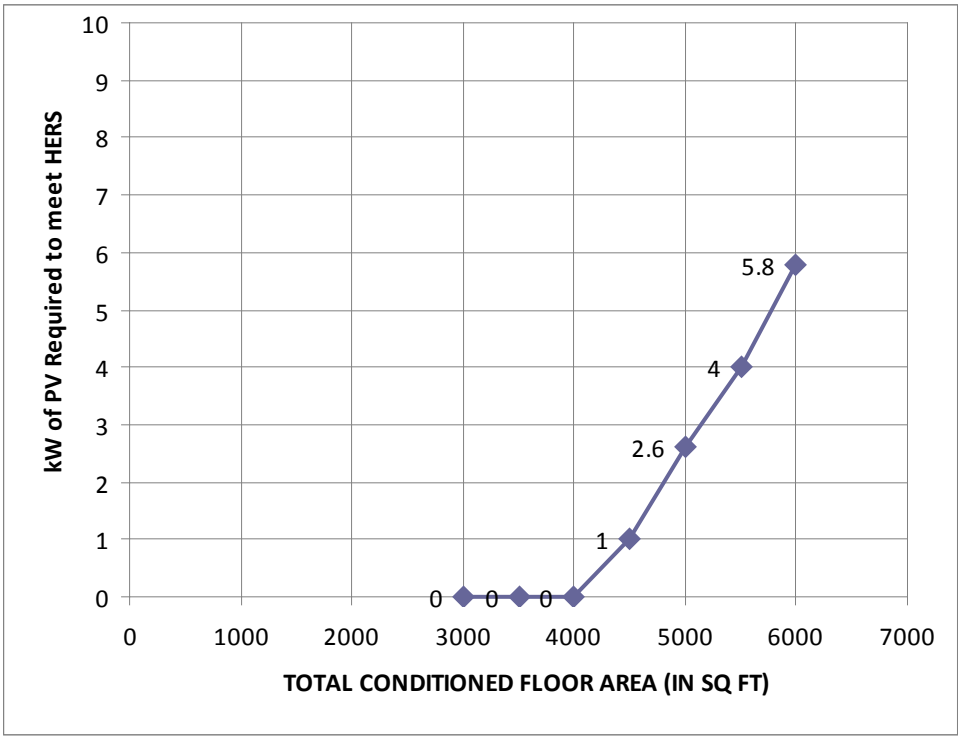


If the gross wall to floor area ratio is greater than one you, the Performance Path Option must be used.

Note: In calculating the wall to floor area ratio the following must be included:

- *The entire floor area within the inside face of the exterior wall.*
- *The wall area measured from the top of the floor to the bottom of the ceiling including all door and window openings.*
- *The floor gross floor area is divided by the gross wall area.*

Table 4
PV Requirements for Additions



If the gross wall to floor area ratio is greater than one the Performance Path Option must be used.

<u>Note: In calculating the wall to floor area ratio the following must be included:</u>

- *The entire floor area within the inside face of the exterior wall.*
- *The wall area measured from the top of the floor to the bottom of the ceiling including all door and window openings.*
- *The floor gross floor area is divided by the gross wall area.*