

UDC Energy Worksheet Example

The UDC Energy Worksheet is required to be submitted with building plans for plan review prior to issuance of a building permit. Following is a sample dwelling and completed Energy Worksheet. **The sample completed worksheet has been completed for both the Prescriptive Package and System Design Methods for demonstration purposes. Normally only one method is required to be completed for showing code compliance.**

Sample dwelling: Non-Electrically heated single-family dwelling located in Dane County (Zone 3). Has 1,500 square feet and 186 linear feet of perimeter building thermal envelope. Garage is not heated. Estimated infiltration rate is 0.3 air changes per hour. There will be 170 cfm of installed exhaust ventilation.

Gross Above-Foundation Walls:

Wall = 8.09' (97"-1/8") x 186 linear feet = 1,504 square feet	
Box sill = 0.81 feet (9-3/4 inches deep: sill, header, subfloor) x 186 linear feet = 151 square feet	
Wood 1 x 8-inch drop siding	R = 0.79
1-inch extruded polystyrene sheathing	R = 5
R13 batt insulation	R = 13
2 x 4 framing, 16 inches O.C.	R = 4.4
1/2-inch drywall finish	R = 0.56

Door area = 38 sq ft

Insulated steel doors	U = 0.35
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Windows:

Above-Foundation Windows - 150 sq ft	
Wood, low-E, argon-filled, double-pane with 1/2" air space, rated by NFRC	U = 0.35
Foundation wall window area = 20 square feet	
Operable metal w/o thermal break, double pane	U = 0.87

Foundation - 8 ft high, 1 ft exposed

8-inch poured concrete	R = 0.8
1-inch extruded polystyrene for full height	R = 5

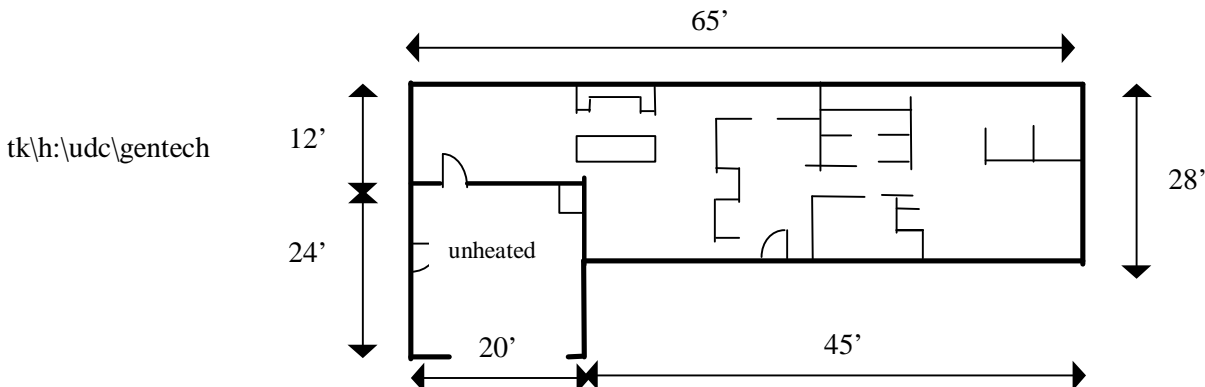
Ceiling - 1,500 square feet, standard roof trusses (no raised heel)

2 x 4 trusses, 24 inches O.C.	R = 4.4
Blown fiberglass insulation	R/inch = 2.5
Insulation in cavity, 16 inches	R = 40
Insulation over framing, 12.5 inches	R = 31.25
5/8-inch drywall finish	R = 0.56

Heating Plant

Gas-Fired Hot Air, 90% AFUE

High Efficiency



Submit completed worksheet pages 3-6 with dwelling plans to local enforcing municipality.

Sample - Zone 3

Project Address: _____

Builder: _____ Owner: _____

Worksheet Completed By: _____ Date: _____

Does dwelling unit have three kilowatts or more input capacity of permanently installed electrical space heating equipment?

YES (see below) NO

You will need to apply the stricter standards shown for electrically-heated homes if you answered "YES" to the above question.

A. Area Calculations

Enter appropriate dimensions to obtain area values. Some calculations will not be necessary depending on home design or calculation method. These calculated areas are referenced elsewhere on this worksheet, for example, "(A.1.)".

<p>1. Window, Skylight & Patio Door Area (overall unit area) a. In Above- Foundation Walls b. In Foundation Walls</p> <p align="center">150 20 sq. ft. sq. ft.</p> <p>c. Total (a. + b.) = 170 sq. ft.</p>	<p>2. Opaque Door Area a. In Above- Foundation Walls b. In Foundation Walls</p> <p align="center">38 0 sq. ft. sq. ft.</p> <p>c. Total (a. + b.) = 38 sq. ft.</p>
<p>3. Gross Exposed Basement Wall Area</p> <p align="center">1' x 186'</p> <p align="right">186 sq. ft.</p>	<p>4. Basement Wall Area Below Grade</p> <p align="center">7' x 186'</p> <p align="right">1302 sq. ft.</p>
<p>5. Opaque [1] Basement Wall Area (A.3. + A.4. - A.1.b.- A.2.b.)</p> <p align="center">186 + 1302 - 20 - 0</p> <p align="right">1468 sq. ft.</p> <p>If the exposed area of A.3. is greater than the below grade area of A.4., add A.5. to A.7 and cross out the number in this cell.</p>	<p>6. Gross Heated Above-Foundation Wall Area, including boxsill</p> <p align="center">1504 + 151</p> <p align="right">1655 sq. ft.</p>
<p>7. Above Foundation Code Wall Area (A.6. + A1.b. + A.2.b.)</p> <p align="center">1655 + 20 + 0</p> <p align="right">1675 sq. ft.</p>	<p>8. Opaque [1] Above-Foundation Wall Area (A.6. - A1.a. - A.2.a.)</p> <p align="center">1655 - 150 - 38</p> <p align="right">1467 sq. ft.</p>
<p>9. Floor Area Over Interior Unconditioned Spaces Less Than 50°</p> <p align="center">0 sq. ft.</p>	<p>10. Insulated Roof Or Ceiling (less skylights)</p> <p align="center">28 x 45 = 1260 12 x 20 = 240</p> <p align="right">1500 sq. ft.</p>
<p>11. Exterior Floor Area (Overhangs)</p> <p align="center">0 sq. ft.</p>	<p>12. Crawl Space Wall Area</p> <p align="center">0 sq. ft.</p>
<p>13. Slab On Grade (above or less than 12 inches below grade)</p> <p align="center">0 lineal feet of slab perimeter</p>	<p>14. Total Heated Envelope Area (A.5 + A.7 + A.9 + A.10 + A.11 + A.12 + (A.13. X 2'))</p> <p align="center">1468 + 1675 + 0 + 1500 + 0 + 0 + 0</p> <p align="right">4643 sq. ft.</p>
<p>15. Percent Glazing (for Prescriptive Package Method, Section B, only) (A.1.c. ÷ A.7. X 100%)</p> <p align="center">170 1675 x 100%</p> <p align="right">10.2 %</p>	<p>16. Windows Description - Above-Foundation Windows:</p> <p>Frame type: <input checked="" type="checkbox"/> Wood or Wood Clad <input type="checkbox"/> Vinyl <input type="checkbox"/> Metal</p> <p>Glazing type: <input checked="" type="checkbox"/> Dual <input type="checkbox"/> Triple <input type="checkbox"/> Dual w/storm panel</p> <p>Dual-Glazing Air Space: <input type="checkbox"/> 1/4" <input type="checkbox"/> 3/8" <input checked="" type="checkbox"/> 1/2" or more</p> <p>Features: <input checked="" type="checkbox"/> Low-E <input checked="" type="checkbox"/> Argon-filled <input type="checkbox"/> Suspended film</p> <p>Foundation Windows: <input type="checkbox"/> Vinyl <input checked="" type="checkbox"/> Metal</p>

B. Prescriptive Package Method (Skip this section if using the System Design Method of Sections C-F)

The prescriptive package method is the simplest method for determining compliance with the UDC insulation and window requirements. To use the prescriptive package method, enter your actual design values in the "Actual" row below. **For a component, with two or more areas of different insulation levels, such as windows,** either use the least insulating value for both areas or use the Weighted Average tables below. Multiply your % glazing by the glazing U-value to obtain your "Glazing Factor". Find the Prescriptive Table that applies to your space heating fuel and sheathing type. Select a package from the table that most closely matches the construction indicated on your plans. **Do not exceed the package U-values or glazing factor or fall below the package R-values with your design.** Transfer the R-Values and U-values to the blank table below in the "Allowed" row. Then proceed to Section F. See page 2 for detailed instructions for this section.

	Package #	% glazing	U glazing	Glazing Factor (% glazing × U glazing)	R wall	R ceiling	R Bsm ^t Crawl Space, Slab or Floor	U door	U overall	Equip. Eff.
Actual	-----	10.2 % (A.15)	0.41	0.042	R13 + 5	R40	R5	0.35	-----	High
Allowed	45	-----	-----	0.0504 Max	R18, 1 Min	R40 Min	R5 Min	0.35 Max	0.086	High

(Please go to Section F.)

Optional R-Value/U-Value Weighted Average Table for Component: Windows

Component Construction Description	R Value	U-Value (1÷R Value)	Area (sq ft)	U-Value × Area (UA)
Basement windows		0.87	20	17.4
Above-foundation windows		0.35	150	52.5
			Total Area = 170	Total UA = 69.9

$$\frac{69.9}{(\text{Total UA})} \div \frac{170}{(\text{Total Area})} = \frac{0.41}{(\text{Weighted Average U-Value (for windows or doors)})}$$

$$\frac{\quad}{(\text{Total Area})} \div \frac{\quad}{(\text{Total UA})} = \frac{\quad}{(\text{Weighted Average R-Value (for all other components)})}$$

Optional R-Value/U-Value Weighted Average Table for Component:

Component Construction Description	R Value	U-Value (1÷R Value)	Area (sq ft)	U-Value × Area (UA)
			Total Area =	Total UA =

$$\frac{\quad}{(\text{Total UA})} \div \frac{\quad}{(\text{Total Area})} = \frac{\quad}{(\text{Weighted Average U-Value (for windows or doors)})}$$

$$\frac{\quad}{(\text{Total Area})} \div \frac{\quad}{(\text{Total UA})} = \frac{\quad}{(\text{Weighted Average R-Value (for all other components)})}$$

Because the sample house fit a Package, you would normally skip ahead to Section F. For demonstration purposes here, the System Design Method is also completed.

C. Code-Allowed Heat Loss For System Design Method

Enter area values from Section A as notated and temperature differences per footnote 2 into this table and then multiply across by the electric or non-electric code-required U-value. Total the right column to find the total allowed heat loss factor.

Component	Area From Sect A.	Required U-Value		= Heat Loss UA
		<input checked="" type="checkbox"/> NON-ELEC	<input type="checkbox"/> ELECTRIC	
1. Opaque Basement Wall [2]	1468 (A.5.)	0.077	0.077	113
2. Above Foundation Code Wall	1675 (A.7.)	0.110	0.080	184
3. Floor Over Interior Unconditioned Space	(A.9.)	0.050	0.050	
4. Roof or Ceiling	1500 (A.10.)	0.026	0.020	39
5. Floor Over Exterior	(A.11.)	0.033	0.033	
6. Crawl Space Wall	(A.12.)	0.060	0.060	
7. Slab On Grade [3]	(A.13.) Lin. ft.	0.72 'F'	0.68 'F'	
<input type="checkbox"/> Unheated <input type="checkbox"/> Heated		0.70 'F'	0.68 'F'	
8. Subtotal				336
9. Credit for High Efficiency Heating Plant: 1.18 for furnace or boiler ≥90% AFUE; 1.15 for heat pump ≥ 7.8 HPSF, Otherwise use 1.0				1.18
10.	Total Code-Allowed Heat Loss Factor			396.5

D. System Design Method - Actual 'U' Values Of Your Home's Components

D.1. Above-Foundation Components - If applicable, check the appropriate typical component constructions listed below, and use the pre-calculated U values. If your wall construction is not listed, you may obtain a pre-calculated U value from the default U-Value tables in the UDC Appendix. (Note that the default Table 2 Wood Frame U-values assume no insulating sheathing which penalizes you if your wall does have insulating sheathing, then you may need to use the Manual Calculation section below.) If you are using exterior metal framing, then you must use the Metal-Frame Wall U-Values of the UDC Appendix. If your component construction is not listed here or in the default tables, you need to use the Manual Calculation section below to manually enter R-values for the different layers of building materials from the Typical Thermal Properties of Building Materials Table of the UDC Appendix, ASHRAE Fundamentals Manual or manufacturer's specifications. Total them across and then obtain the U-value by taking the reciprocal (1/R) of the total R-value.

Above-Foundation Walls	<input type="checkbox"/> 2X4, 16" O.C., R-13 batt, R-1 board: U - .079	<input type="checkbox"/> 2X4, 16" O.C., R-13 batt, R-5 board: U - .061									
	<input type="checkbox"/> 2X6, 16" O.C., R-19 batt, R-1 board: U - .059	<input type="checkbox"/> 2X6, 16" O.C., R-19 batt, R-5 board: U - .049									
<input type="checkbox"/> Other - describe:	U - _____ from Default Table										
Roof or Ceiling	<input type="checkbox"/> 2X4 truss, 24" O.C., with R-38 insulation: U - .030	<input type="checkbox"/> 2X4 truss, 24" O.C., with R-52 insulation: U - .025									
	<input type="checkbox"/> 2X12 cathedral ceiling, 16" O.C., with R-38 insulation U - .027										
<input checked="" type="checkbox"/> Other - describe: R40 with regular trusses	U - 0.029 from Default Table 1										
Floor Over Exterior or Unconditioned Space	<input type="checkbox"/> 2X10 joists, 16" O.C., R-19 batt: U - .047										
<input type="checkbox"/> Other - describe:	U - _____ from Default Table										
Optional Manual U-Value Calculation (if assembly not listed above)											
Component Name	Cavity Or Solid If Applicable	Ext. Air Film*	Ext. Finish	Insulation Over Framing	Sheathing	Framing Or Solid	Insulation Within Cavity	Interior Finish	Int. Air Film*	Total R-Value	U-Value (1/R)
Above Foundation Wall	Cavity	.17	0.79	5.0		-----	13	0.56	.68	20.2	.050
	Solid	.17	0.79	5.0		4.4	-----	0.56	.68	11.6	.086
	Cavity					-----					
	Solid					-----					

* Air Film R-Values

Location	Heat Flow Direction		
	Upwards	Horizontal	Downwards
Exterior	.17	.17	.17
Interior	.61	.68	.92

D.2. Foundation And Slab-On-Grade Components - Check appropriate boxes for planned type of construction to determine pre-calculated overall 'U-value' including air films, wall, insulation, soil and cavity/solid differences. Slab on grade F-values are per lineal foot of slab perimeter.

Component Type	U-Value	
	Basement	Crawl Space
Foundation Wall		
<input type="checkbox"/> Masonry or concrete wall without insulation	0.360	0.477
<input checked="" type="checkbox"/> Masonry or concrete wall with R-5 insulation board for full height	0.115	0.136
<input type="checkbox"/> Masonry or concrete wall with R-10 insulation board or R-11 insulation batt and 2X4's for full height	0.072	0.081
<input type="checkbox"/> Permanent wood foundation with R-19 batt for full height	0.054	0.059
<input type="checkbox"/> Basement or crawl space floor without insulation	0.025	0.025
Slab-On-Grade (or within 12" of grade)	F-Value	
<input type="checkbox"/> Slab-on-grade without insulation	1.04	
<input type="checkbox"/> Slab-on-grade with R-5 insulation for 48" total horizontal and vertical application	0.74	
<input type="checkbox"/> Slab-on-grade with R-10 insulation board for 48" total application	0.68	

D.3. Windows And Doors - Use manufacturer's specifications for window and glazed door values, if they were determined per NFRC Std 100, to enter into Table E. Otherwise see default tables of UDC s. Comm 22.05 for U-values.

E. System Design Method - Calculated Envelope Heat Loss Factor Of Your Home

Enter values into table from elsewhere on this worksheet and multiply across to find the actual heat loss factor of each component. If using pre-calculated component U-values, **do not calculate separate cavity and solid figures or apply wood frame factors**. Total component heat loss factors in right column to find total envelope heat loss factors.

Component	Cavity Or Solid If Applicable	Area From Sect. A	Wood Frame Factor**	Actual 'U' Value From Sect. D	= Heat Loss Factor (UA)
Above-Foundation Windows	-----	150 (A.1.a.)	-----	0.35	52.5
Foundation Windows	-----	20 (A.1.b)	-----	0.87	17.4
Doors	-----	38 (A.2.c)	-----	0.35	13.3
Opaque Basement Wall	-----	1468 (A.5.)	-----	0.115	168.8
Opaque Above-Foundation Wall	Cavity	1467 (A.8.)	.75	.050	55
	Solid		.25	.086	31.5
Floor Over Unconditioned Spaces	Cavity	(A.9.)			
	Solid				
Roof or Ceiling	Cavity	1500 (A.10.)	-----	-----	-----
	Solid		-----	0.029	43.5
Floor Over Exterior	Cavity	(A.11.)			
	Solid				
Crawl Space Wall	-----	(A.12.)	-----		
Slab On Grade	-----	(A.13.)Lin. ft.	-----	F-Value	
Total Calculated Envelope Heat Loss Factor- Not to exceed Total Code Allowed Heat Loss Factor of line 10 of Section C. (Enter here: 396.5) by more than 1%					382

** Adjustment Factors For Wood-Framed Components - Do not apply if your are using a pre-calculated or default U-Value.

Spacing Of Framing Members	Stud Walls		Joists/Rafters	
	Cavity	Solid	Cavity	Solid
12"	.70	.30	.86	.14
16"	.75	.25	.90	.10
24"	.78	.22	.93	.07

F. Heat Loss Factor Due to Air Infiltration (for heating equipment sizing)

Enter appropriate values. A maximum infiltration air change rate of 0.5 per hour is allowed in addition to ventilation losses.

Floor Level	Area (sq ft)	Height (ft)	Fan Capacity (cfm)	Constant	Air Changes Per Hour	= Heat Loss Factor(UA)
Basement	1500	8	-----	.018	0.3	64.8
Level 1	1500	8	-----	.018	0.3	64.8
Level 2			-----	.018		
Level 3			-----	.018		
Ventilation	-----	-----	170	.432	-----	73.4
Total Infiltration & Ventilation Heat Loss Factor						203

G. Heating Equipment Sizing

Enter appropriate value to determine the maximum and minimum allowable heating equipment capacity in BTUs/HR. A more detailed calculation may be submitted to the local code official. [4]

Prescriptive Package Method:	0.086	4643	=	
	U overall from selected Prescriptive Package of Section B	Total Envelope Area (A.14.)		399.3
OR System Design Method: Calculated Heat Loss Factor from Sect. E.				
Infiltration & Ventilation Heat Loss Factor (from Sect. F.)				+ 203
Total Heat Loss Factor (UA)				= 602.3
Temperature Difference from Zone Table on page 1				' 85
Minimum Heating Equipment Output				= 51,196
Allowable Heating Equipment Size Margin Multiplier				' 1.15
Maximum Allowable Heating Equipment Output [5]				= 58,875
Planned Furnace Output Or Boiler IBR Rating				60,000
Make & Model if High Efficiency Credit has been taken:				Acme XLH60K

Prescriptive Package Tables (Corrected)

(See notes on page 2 of Energy Worksheet; I = insulating sheathing, RT = raised heel roof truss)

Table B-1 Prescriptive packages, Non-electric Heat, Structural Sheathing only

Package	Glazing Factor	R wall	R ceiling	R basement	U door	U overall	HVAC Equipment Efficiency
1	0.0370	R21	R42	R7	0.35	0.073	Normal
2	0.0264	R21	R51, RT	R5	0.35	0.073	Normal
3	0.0333	R15	R42	R10	0.35	0.073	Normal
4	0.0440	R19	R33	R10	0.35	0.073	Normal
5	0.0330	R13	R42	R11	0.35	0.073	Normal
6	0.0480	R19	R33	R11	0.35	0.073	Normal
7	0.0600	R21	R47	R11	0.35	0.073	Normal
8	0.0407	R13	R44	R13	0.35	0.073	Normal
9	0.0600	R19	R42	R13	0.35	0.073	Normal
10	0.0680	R21	R38, RT	R13	0.35	0.073	Normal
11	0.0296	R13	R49	R5	0.35	0.086	High
12	0.0440	R19	R30	R5	0.35	0.086	High
13	0.0520	R21	R33	R5	0.35	0.086	High
14	0.0720	R13	R47	R10	0.35	0.086	High
15	0.0784	R19	R38	R10	0.47	0.086	High
16	0.0640	R13	R33	R11	0.47	0.086	High
17	0.0896	R19	R49	R11	0.35	0.086	High
18	0.0896	R21	R34	R11	0.35	0.086	High
19	0.0920	R19	R34	R11	0.47	0.086	High
20	0.0840	R13	R49	R13	0.35	0.086	High
21	0.0840	R19	R30	R13	0.47	0.086	High
22	0.0896	R21	R31	R13	0.47	0.086	High
Package	Glazing Factor	R wall	R ceiling	R crawl	U door	U overall	HVAC Equipment Efficiency
23	0.0520	R19	R34	R19	0.47	0.070	Normal
24	0.0672	R13	R36	R19	0.47	0.083	High
25	0.0720	R13	R33	R19	0.47	0.083	High
Package	Glazing Factor	R wall	R ceiling	R slab	U door	U overall	HVAC Equipment Efficiency
26	0.0560	R21	R36	R5	0.47	0.103	Normal
27	0.0728	R13	R36	R5	0.47	0.121	High
28	0.0760	R13	R34	R5	0.47	0.121	High
Package	Glazing Factor	R wall	R ceiling	R heated-slab	U door	U overall	HVAC Equipment Efficiency
29	0.0560	R21	R47	R5	0.47	0.101	Normal
30	0.0728	R13	R42	R5	0.47	0.120	High
31	0.0760	R13	R38	R5	0.47	0.120	High
Package	Glazing Factor	R wall	R ceiling	R floor	U door	U overall	HVAC Equipment Efficiency
32	0.0480	R19	R47	R19	0.35	0.065	Normal
33	0.0728	R19	R36	R19	0.47	0.077	High
34	0.0560	R13	R34	R19	0.47	0.077	High

Table B-2 Prescriptive packages, Non-electric Heat, Insulating Sheathing

Package	Glazing Factor	R wall	R ceiling	R basement	U door	U overall	HVAC Equipment Efficiency
35	0.0370	R20, I	R42	R7	0.35	0.073	Normal
36	0.0363	R28, I	R38, RT	R5	0.35	0.073	Normal
37	0.0552	R18, I	R44	R10	0.35	0.073	Normal
38	0.0560	R20, I	R47	R10	0.35	0.073	Normal
39	0.0560	R23, I	R34	R10	0.35	0.073	Normal
40	0.0560	R18, I	R47	R11	0.35	0.073	Normal
41	0.0616	R23, I	R42	R11	0.35	0.073	Normal
42	0.0546	R18, I	R44	R11	0.35	0.073	Normal
43	0.0672	R23, I	R40	R13	0.35	0.073	Normal
44	0.0720	R25, I	R36	R13	0.35	0.073	Normal
45	0.0504	R18, I	R40	R5	0.35	0.086	High
46	0.0560	R19, I	R47	R5	0.35	0.086	High
47	0.0560	R23, I	R38	R5	0.47	0.086	High
48	0.0600	R25, I	R38	R5	0.47	0.086	High
49	0.0680	R26, I	R42	R5	0.35	0.086	High
50	0.0680	R28, I	R47	R5	0.47	0.086	High
51	0.0672	R26, I	R47	R5	0.35	0.086	High
52	0.0672	R28, I	R38	R5	0.35	0.086	High
53	0.0720	R20, I	R42	R7	0.47	0.086	High
54	0.0855	R18, I	R36	R11	0.35	0.086	High