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|     |      |
|-----|------|
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |
| 0.0 | 0.00 |

*Sum of Vertical Fenestration Area and UA*  
*Vertical Fenestration Area Weighted U = UA/Area*

|        |        |
|--------|--------|
| 1390.7 | 417.20 |
|        | 0.30   |

**Overhead Glazing (Skylights)**

| Component<br>Description | Ref. | U-factor |
|--------------------------|------|----------|
|                          |      |          |
|                          |      |          |
|                          |      |          |
|                          |      |          |
|                          |      |          |
|                          |      |          |

| Qt. | Width |      | Height |      |
|-----|-------|------|--------|------|
|     | Feet  | Inch | Feet   | Inch |
|     |       |      |        |      |
|     |       |      |        |      |
|     |       |      |        |      |
|     |       |      |        |      |
|     |       |      |        |      |
|     |       |      |        |      |

| Area | UA   |
|------|------|
| 0.0  | 0.00 |
| 0.0  | 0.00 |
| 0.0  | 0.00 |
| 0.0  | 0.00 |
| 0.0  | 0.00 |
| 0.0  | 0.00 |

*Sum of Overhead Glazing Area and UA*  
*Overhead Glazing Area Weighted U = UA/Area*

|     |      |
|-----|------|
| 0.0 | 0.00 |
|     | 0.00 |

**Total Sum of Fenestration Area and UA (for heating system sizing calculations)**

|        |        |
|--------|--------|
| 1390.7 | 417.20 |
|--------|--------|

# Simple Heating System Size: Washington State

This heating system sizing calculator is based on the Prescriptive Requirements of the 2018 and 2021 Washington State Energy Code (WSEC) . This tool will calculate heating loads only. ACCA procedures for sizing cooling systems should be used to determine cooling loads.

Please complete the green drop-downs and boxes that are applicable to your project. As you make selections in the drop-downs for each section, some values will be calculated for you. If you do not see the selection you need in the drop-down options, please contact the WSU Energy Program at [energycode@energy.wsu.edu](mailto:energycode@energy.wsu.edu) or (360) 956-2042 for assistance.

This tool is for the permitting purposes only. A Manual J calculation is required to meet the requirement of the Washington State Energy Code.

### Project Information

SEARS PLAT - LOT 3  
 97414 - 78th Avenue SE  
 Mercer Island, WA 98040

### Contact Information

McCullough Architects  
 5601 - 6th Ave S, #317  
 Seattle, WA 98108

**Heating System Type:**  All Other Systems  Heat Pump

To see detailed instructions for each section, place your cursor on the word "Instructions"

### Design Temperature

[Instructions](#)

Mercer Island

Design Temperature 25  
 Design Temperature Difference ( $\Delta T$ ) 45  
 $\Delta T = \text{Indoor (70 degrees)} - \text{Outdoor Design Temp}$

### Area of Building

#### Conditioned Floor Area

[Instructions](#)

Conditioned Floor Area (sq ft)

4,335

#### Average Ceiling Height

[Instructions](#)

Average Ceiling Height (ft)

10.0

Conditioned Volume  
 43,350

### Glazing and Doors

[Instructions](#)

U-0.30

**U-Factor X Area = UA**  
 0.300 1,391 417.30

### Skylights

[Instructions](#)

None

**U-Factor X Area = UA**  
 0.50 0 0.00

### Insulation

#### Attic

[Instructions](#)

R-60

**U-Factor X Area = UA**  
 0.024 2,275 54.60

#### Single Rafter or Joist Vaulted Ceilings

[Instructions](#)

None

**U-Factor X Area = UA**  
 -- 0 --

#### Above Grade Walls (see Figure 1)

[Instructions](#)

R-21 Intermediate

**U-Factor X Area = UA**  
 0.056 3,140 175.84

#### Floors

[Instructions](#)

R-38

**U-Factor X Area = UA**  
 0.025 2,247 56.18

#### Below Grade Walls and Slabs (see Figure 1)

[Instructions](#)

Wall & Slab None  
 Depth Select nearest slab depth

**Wall U-Factor X Area = UA**  
 -- 0 --  
**Slab F-Factor X Length = UA**  
 -- 0 --

#### Slab on Grade (see Figure 1)

[Instructions](#)

None

**F-Factor X Length = UA**  
 -- 59 --

### Location of Ducts

[Instructions](#)

Unconditioned Space

**Duct Leakage Coefficient**  
 1.100

**Sum of UA** 703.92  
**Envelope Heat Load** 31,676 Btu / Hour  
Sum of UA x  $\Delta T$   
**Air Leakage Heat Load** 21,068 Btu / Hour  
Volume x 0.6 x  $\Delta T$  x 0.018  
**Building Design Heat Load** 52,744 Btu / Hour  
Air leakage + envelope heat loss  
**Building and Duct Heat Load** 58,019 Btu / Hour  
Ducts in unconditioned space: sum of building heat loss x 1.10  
 Ducts in conditioned space: sum of building heat loss x 1  
**Maximum Heat Equipment Output** 72,523 Btu / Hour  
Building and duct heat loss x 1.40 for forced air furnace  
 Building and duct heat loss x 1.25 for heat pump

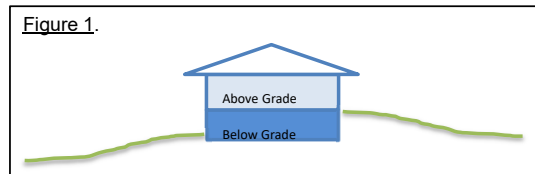


Figure 1.



Caution: Photovoltaic system performance predictions calculated by PVWatts® include many inherent assumptions and uncertainties and do not reflect variations between PV technologies nor site-specific characteristics except as represented by PVWatts® inputs. For example, PV modules with better performance are not differentiated within PVWatts® from lesser performing modules. Both NREL and private companies provide more sophisticated PV modeling tools (such as the System Advisor Model at //sam.nrel.gov) that allow for more precise and complex modeling of PV systems.

The expected range is based on 30 years of actual weather data at the given location and is intended to provide an indication of the variation you might see. For more information, please refer to this NREL report: The Error Report.

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The energy output range is based on analysis of 30 years of historical weather data, and is intended to provide an indication of the possible interannual variability in generation for a Fixed (open rack) PV system at this location.

# RESULTS

# 5,269 kWh/Year\*

System output may range from 5,029 to 5,447 kWh per year near this location.

| Month         | Solar Radiation<br>( kWh / m <sup>2</sup> / day ) | AC Energy<br>( kWh ) |
|---------------|---|----------------------|
| January       | 1.43  | 178                  |
| February      | 2.32  | 263                  |
| March         | 3.19  | 392                  |
| April         | 4.77  | 554                  |
| May           | 5.13  | 609                  |
| June          | 5.66  | 631                  |
| July          | 6.22  | 709                  |
| August        | 5.90  | 680                  |
| September     | 4.61  | 522                  |
| October       | 2.80  | 340                  |
| November      | 1.71  | 208                  |
| December      | 1.45  | 184                  |
| <b>Annual</b> | <b>3.77</b>                                       | <b>5,270</b>         |

## Location and Station Identification

|                     |                                    |
|---------------------|------------------------------------|
| Requested Location  | 7414 78th avenue se, mercer island |
| Weather Data Source | Lat, Lng: 47.53, -122.22 0.8 mi    |
| Latitude            | 47.53° N                           |
| Longitude           | 122.22° W                          |

## PV System Specifications

|                       |                   |
|-----------------------|-------------------|
| DC System Size        | 5 kW              |
| Module Type           | Standard          |
| Array Type            | Fixed (open rack) |
| System Losses         | 14.08%            |
| Array Tilt            | 20°               |
| Array Azimuth         | 180°              |
| DC to AC Size Ratio   | 1.2               |
| Inverter Efficiency   | 96%               |
| Ground Coverage Ratio | 0.4               |
| Albedo                | From weather file |
| Bifacial              | No (0)            |

|                         |      |     |      |     |     |      |
|-------------------------|------|-----|------|-----|-----|------|
| Monthly Irradiance Loss | Jan  | Feb | Mar  | Apr | May | June |
|                         | 0%   | 0%  | 0%   | 0%  | 0%  | 0%   |
| Monthly Irradiance Loss | July | Aug | Sept | Oct | Nov | Dec  |
|                         | 0%   | 0%  | 0%   | 0%  | 0%  | 0%   |

|  |
|--|
| <b>Project Information</b>   |
| 7414 - 78th Avenue East<br>Mercer Island, WA 98040<br>Sears Plat - Lot 3             |
| <b>Contact Information</b>   |
| McCullough Architects<br>5601 - 6Th Ave S, #317<br>Seattle, WA 98108<br>206-443-1181 |

|   |                     |
|---|---------------------|
| <b>Messages / Comments *</b>  | <b>RESULT= PASS</b> |
| UA Reduction = 31.3, Proposed UA is better than baseline by 4%<br><br>Window area is 32% of floor area<br>-<br>Whole House Mechanical Ventilation Airflow Rate: 168.75 CFM with Run Time Percent of 66%, Balanced, Not Distributed<br>Maximum allowable total measured duct leakage: 173 CFM25<br><small>* Results assume your inputs are complete and correct. Results do not constitute an approval. Analysis should be reviewed by your AHJ.</small> |                     |

|   |   |
|---|---|
| <b>ANALYSIS SET UP</b>                      |   |
| What code compliance pathway are you using? | <b>U-Factor Compliance Path</b>                               |
| Project Building Type?                      | <b>New Construction</b>                                       |
| Occupancy Type?                             | <b>R3 Single family dwellings and townhouses</b>              |
| Code Version?                               | <b>WSEC 2021</b>  |
| Classification:                             | Medium Dwelling Unit -- 4335 sq. ft.                          |
| Baseline Description:                       | Code Baseline - Baseline and proposed window areas are equal. |
| About Your Selection:                       | Up to 15 sf exempt window and 24 sf exempt door allowable     |

|   |  |             |                        |                             |                                 |           |
|---|--|-------------|------------------------|-----------------------------|---------------------------------|-----------|
| <b>RESULTS - Comparison of Baseline and Proposed Design **</b>  |  |             |                        |                             |                                 |           |
| <b>Component Performance, R occupancies</b>   |  |             | <b>Proposed Design</b> |                             |                                 |           |
|   | <b>Baseline Design</b>                                 |             |                        | <b>Proposed Design</b>      |                                 |           |
|   | <b>U *</b>   | <b>Area</b> | <b>UA</b>              | <b>U</b>                    | <b>Area</b>                     | <b>UA</b> |
| Doors U =   | 0.300  | 0           | 0.0                    |                             | 0                               | 0.0       |
| Overhead Glazing U =  | 0.500  | 0           | 0.0                    |                             | 0                               | 0.0       |
| Vertical Glazing U =  | 0.300  | 1,391       | 417.3                  | 0.300                       | 1,391                           | 417.3     |
| Flat/Vaulted Ceilings U =   | 0.024  | 2,275       | 54.6                   | 0.017                       | 2,275                           | 38.7      |
| Wall (above grade) U =  | 0.056  | 3,140       | 175.8                  | 0.054                       | 3,140                           | 169.6     |
| Floors over Crawlspace U =  | 0.029  | 2,522       | 73.1                   | 0.025                       | 2,522                           | 64.0      |
| Slab on Grade F =   | 0.540  | 59          | 32.0                   | 0.540                       | 59                              | 32.0      |
| Below Grade Wall U =  | N/A  | 0           |                        |                             | 0                               | 0.0       |
| Below Grade Slab F =  | N/A  | 0           |                        |                             | 0                               | 0.0       |
|   | <small>* Values from Table R402.1.2 (Oct 2023)</small> |             |                        |                             |                                 |           |
|   | <b>Baseline UA Total</b>                               | 752.9       |                        | <b>Proposed UA Total</b>    | 721.6                           |           |
|   | <b>Required Credits</b>                                | 8.0         |                        | <b>Proposed Credits</b>     | 8.0 from Tables 406.2 and 406.3 |           |
|   |  |             |                        | <b>UA Percent Reduction</b> | 4%                              |           |
|   |  |             |                        | <b>UA Reduction</b>         | 31.3                            |           |
| If the Proposed UA ≤ the Target UA, and the Proposed Credits from Table 406 are ≥ those required in Section R406, then the home meets the WSEC. |  |             |                        |                             |                                 |           |

\*\* Results assume your inputs are complete and correct. Results do not constitute an approval. Analysis should be reviewed by your AHJ.

| <b>Table R406.2 Energy Equalization Credits</b> |  |  |                                    |                        |                               |
|---|--|--|------------------------------------|------------------------|-------------------------------|
| System No.                                      | Full Description   | Select System Type                         | Fuel Normalization Credits (406.2) | Energy Credits (406.3) | Total Credits (406.2 & 406.3) |
| 2   | For heating system using a heat pump that meets federal standards for the equipment listed in Table C403.3.2(2) and supplemental heating provided by electric resistance or a combustion furnace meeting minimum standards Listed in Table C403.3.2(5)b found in the 2021 WSEC - COMMERCIAL ENERGY CODE. | <b>Heat Pump with Supplemental Heating</b> | 1.5                                | 6.5                    | 8.0                           |

| <b>Table R406.3 Energy Credits</b> |   |                     |                |  |
|------------------------------------|---|---------------------|----------------|--|
| Option No.                         | Category                                      | Select Options      | Energy Credits | Brief Description of Selected Options* |
| 1                                  | Efficient Building Envelope                   | <b>Not Selected</b> | 0.0            | -                                      |
| 2                                  | Air Leakage Control and Efficient Ventilation |                     |                |  |
| 3.1-3.10                           | High Efficiency HVAC                          |                     | 0.0            |  |
| 3.11                               | High Efficiency HVAC: Smart Thermostat        | <b>Not Selected</b> | 0.0            |  |
| 4                                  | High Efficiency HVAC Distribution System      |                     | 0.0            |  |

|                       |   |           |              |            |  |
|-----------------------|---|-----------|--------------|------------|--|
| 5.1                   | Efficient Water Heating: Drain Heat Recovery            |           | Not Selected | 0.0        | -  |
| 5.2                   | Efficient Water Heating: Compact Hot Water Distribution |           | Not Selected | 0.0        | -  |
| 5.3-5.8               | Efficient Water Heating                                 |           | Option 5.6   | 2.0        | Electric heat pump water heater meeting NEEA Tier 3.   |
| 6                     | Renewable Electric Energy                               | 5,400 kWh | Option 6.1   | 4.5        | On-site wind or solar electric energy, 0.5 credit per 600 kWh of generation up to maximum of 4.5 credits |
| 7                     | Appliance Package                                       |           |              | 0.0        |  |
| <b>Energy Credits</b> |   |           |              | <b>6.5</b> |  |

\*Refer to WSEC 2021 Table R406.3 for complete option descriptions and requirements <https://sbcc.wa.gov/state-codes-regulations-guidelines/state-building-code/energy-code>





| Floor (over crawl or exterior) |                                  |      |         |  |       |       |
|--------------------------------|----------------------------------|------|---------|--|-------|-------|
| Plan ID                        | Component Description            | Ref. | Floor U |  | Area  | UA    |
| F3                             | R38 vented Joist                 | 10-3 | 0.025   |  | 2,275 | 57    |
| F2                             | R30 vented Joist (Code Baseline) | 10-3 | 0.029   |  | 247   | 7     |
|                                |                                  |      |         |  |       |       |
|                                |                                  |      |         |  |       |       |
| Sum of Area and UA             |                                  |      |         |  | 2,522 | 64    |
| Area Weighted U-Value          |                                  |      |         |  |       | 0.025 |

| Slab on Grade (less than 2 feet below grade) |   |              |        |  |            |       |
|--|---|--------------|--------|--|------------|-------|
| Plan ID                                      | Component Description                   | Ref.         | Slab F |  | Slab Perim | FP    |
| S1   | 2021 U-factor Baseline (Table R402.1.2) | Table R402.1 | 0.540  |  | 59         | 32    |
|  |   |              |        |  |            |       |
|  |   |              |        |  |            |       |
| Sum of Perimeter and FP                      |   |              |        |  | 59         | 32    |
| Area Weighted U-Value                        |   |              |        |  |            | 0.540 |

| Below Grade Walls and Slabs |                       |            |      |        |           |         |        |            |         |   |
|-----------------------------|-----------------------|------------|------|--------|-----------|---------|--------|------------|---------|---|
| Plan ID                     | Component Description | Slab Depth | Ref. | Wall U | Wall Area | Wall UA | Slab F | Slab Perim | Slab UA |   |
|                             |                       |            |      |        |           |         |        |            |         |   |
|                             |                       |            |      |        |           |         |        |            |         |   |
|                             |                       |            |      |        |           |         |        |            |         |   |
| Sum of Area, Length and UA  |                       |            |      |        |           | 0       | 0      |            | 0       | 0 |
| Weighted U- and F-values    |                       |            |      |        |           |         |        |            |         |   |

| Links to Download Forms, Checklists and Other Resources |                       | Link  |
|---|-----------------------|---|
| Compliance Certificate                                  |                       | <a href="#">Compliance Certificate</a>  |
| Insulation Certificate for Residential New Construction |                       | <a href="#">Insulation Certificate</a>  |
| Duct Testing Affidavits                                 |                       |   |
|   | Existing Construction | <a href="#">Affidavit, Existing</a>   |
|   | New Construction      | <a href="#">Affidavit, New</a>  |
| Prescriptive Checklist for 2018 WSEC                    |                       | <a href="#">Prescriptive Checklist</a>  |
| Alterations (Remodel) Worksheet                         |                       | <a href="#">Worksheet</a>   |
| EER SEER2 COP HSPF2 Converter                           |                       | <a href="https://www.adicotengineering.com/eer-seer2-cop-hspf2-kwton-converter">https://www.adicotengineering.com/eer-seer2-cop-hspf2-kwton-converter</a> |

| Show Ventilation Calculator?                    |                 | Show   |
|---|-----------------|--|
| <b>Ventilation Requirements</b>                 |                 |  |
| Conditioned Floor Area                          | 4,335 sq. ft.   |  |
| Number of Bedrooms                              | 5               |  |
| Run-Time Percent in Each 4-Hour Segment         | 66%             |  |
| Is the system Balanced?                         | Balanced        | Verify system meets definition of 'Balanced Whole-House Ventilation' |
| Is the system Distributed?                      | Not Distributed |  |
| Ventilation Code Section                        | IRC, Chapter 15 |  |
| Whole House Mechanical Ventilation Airflow Rate | 169 CFM         |  |

| Show Distribution System Calculator?                |                        | Show |
|---|------------------------|------|
| <b>HVAC Thermal Distribution System</b>             |                        |      |
| Is this a hydronic heating system?                  | No                     |      |
| Location of Ducts                                   | Unconditioned Space    |      |
| Location of Air Handler                             | Unconditioned Space    |      |
| Is Duct Testing Required?                           | Yes                    |      |
| Maximum Duct Leakage:                               |                        |      |
| Is this a post-construction test?                   | Yes                    |      |
| Maximum total measured duct leakage per square foot | 0.04 CFM25 per sq. ft. |      |
| Maximum allowable total measured duct leakage       | 173 CFM25              |      |

| Show Heating System Sizing?   |               | Show |
|---|---------------|------|
| <b>Heating System Sizing - Proposed Design</b>  |               |      |
| Try Out BetterBuiltNW's HVAC Sizing Tool: <a href="https://betterbuiltinw.com/resources/hvac-sizing-tool">https://betterbuiltinw.com/resources/hvac-sizing-tool</a> |               |      |
| Nearest Weather Station   | Mercer Island |      |
| Indoor Design Temperature   | 70 F          |      |
| Outdoor Design Temperature  | 25 F          |      |
| Design Temperature Difference (ΔT)  | 45 F          |      |

|  |   |  |
|--|---|--|
| <b>Conditioned Floor Area, Proposed Design</b>   | 4,335 ft <sup>2</sup>                               |  |
| <b>Conditioned Volume</b>  | <input type="text" value="49,950"/> ft <sup>3</sup> | <b>Ave ceiling = 11.5 ft. Check: Higher than expected conditioned volume</b> |
| <small>Leave blank to use default of 8.5 ft. ceiling height</small>                              |   |  |
| <b>Average ceiling height</b>  | 11.5 ft   |  |
| <b>HVAC System Type</b>  | <input type="text" value="Heat Pump"/>              |  |
| <b>Location of HVAC Distribution System</b>  | Unconditioned Space                                 |  |
| <b>Sum of UA, including exempt door and window</b>   | <input type="text" value="722"/>                    |  |
| <b>Envelope Heat Load</b>  | <input type="text" value="32,473"/> Btu / Hour      |  |
| <small>Sum of UA X ΔT</small>  |   |  |
| <b>Air Leakage Heat Load</b>   | <input type="text" value="24,276"/> Btu / Hour      |  |
| <small>((Volume X 0.6) X ΔT) X .018))</small>  |   |  |
| <b>Building Design Heat Load</b>   | <input type="text" value="56,748"/> Btu / Hour      |  |
| <small>Air Leakage + Envelope Heat Loss</small>  |   |  |
| <b>Building and Duct Heat Load</b>   | <input type="text" value="62,423"/> Btu / Hour      |  |
| <small>For ducts located in unconditioned space: Sum of Building Heat Loss X 1.1</small>         |   |  |
| <small>For ducts located in conditioned space or ductless: Sum of Building Heat Loss X 1</small> |   |  |
| <b>Maximum Heat Equipment Output</b>   | <input type="text" value="78,029"/> Btu / Hour      |  |
| <small>Building and Duct Heat Loss X 1.25 for heat pumps</small>                                 | <input type="text" value="22.9"/> kW                |  |
| <small>Building and Duct Heat Loss X 1.40 for all other systems</small>                          |   |  |