Sizing Discussion for DEER Prototypes

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June 14, 2024

Background

A. Single-Family and Low-rise Multifamily models

In the scope of residential HVAC system design, the standard approach is to follow the Air Conditioning Contractors of America (ACCA) Manual J load calculations. This methodology is widely used to determine both the capacity and sizing requirements. It is a fundamental protocol employed by HVAC professionals - contractors, technicians, and installers alike - to ensure that the capacity is sized to supply heating and cooling peak loads for various residential structures, including single-family homes, small multi-unit buildings, condominiums, townhouses, and manufactured homes.

Furthermore, ACCA Manual S (Residential Equipment Selection) is used post-Manual J analysis to guide the selection of HVAC equipment. It sets the upper and lower limits for HVAC equipment total capacity, ensuring not only the adequacy of HVAC equipment but also its optimal performance.

B. Non-residential models

For non-residential models, the standard approach to sizing HVAC systems is outlined in ASHRAE 90.1 Appendix G. Specifically, ASHRAE 90.1 Appendix G3.1.2.2 states that the installed equipment should be oversized by a factor of 1.25 for heating and 1.15 for cooling above the modelled capacity.

The NOR team discussed prototype model HVAC sizing procedures for incentive programs with other industry experts[1] and the approach outlined above matched their experience and standard industry practice.

HVAC Sizing Approach

For both residential (single-family and low-rise multifamily) and non-residential building energy models, the first step will be sizing the HVAC systems using the EnergyPlus's auto-size feature, EnergyPlus, a widely used building energy simulation software, utilizes detailed inputs regarding the building's design, materials, occupancy, and local weather conditions to calculate the heating and cooling loads required to maintain comfortable indoor environments. This sizing approach is also used in ResStock.

Then, as the next step for residential models (both new construction and existing buildings), ACCA Manual J will be used to oversize the HVAC systems, and ACCA Manual S is used to select the system size. For non-residential models (both new construction and existing buildings), an oversize factor of 1.25 for heating and 1.15 for cooling will be applied according to ASHRAE 90.1 Appendix G. This approach is also used in ComStock as well as the Nonresidential ACM Reference Manual (standard models).

[1] NOR Team met with Doug Maddox, who currently works at PNNL and was part of the DEER team for many years.

The two approaches for residential and non-residential models are summarized in the table below.

Category	HVAC Sizing	HVAC Oversizing
Residential: Air conditioning - Heating	Autosized to design day conditions	ACCA Manual J 8th Edition (oversizing) & Manual S 3rd Edition, Version 1.01 (system selection)
Non-Residential: Air conditioning - Heating	Autosized to design day conditions	ASHRAE 90.1 Appendix G3.1.2.2

DEER Prototypes HVAC Sizing and Oversizing Approach

The approach below describes HVAC sizing and oversizing being used for DEER prototype models and is a summary of the approach presented by DNV[2] under the FAQ document on CEDARS website.

- **DEER Commercial prototype models:** scaling sizing factors:
  - **2.3** (1.15*2) for cooling and **2.5** (1.25*2) for heating
- **DEER Residential prototype models:** DNV recommended moving forward with the table below.

[2] https://cedars.sound-data.com/deer-resources/tools/energy-plus/file/3117/download

Climate Zone	AC SFm tons cool capacity	Gas Furnace SFm kBtuh heating capacity	Heat Pump SFm kBtuh heating capacity	AC MFm tons cool capacity	Gas Furnace MFm kBtuh heating capacity	Heat Pump MFm kBtuh heating capacity	AC Dmo tons cool capacity	Gas Furnace Dmo kBtuh heating capacity	Heat Pump Dmo kBtuh heating capacity
1	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
2	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
3	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
4	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
5	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
6	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
7	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
8	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
9	**4.0**	**80.0**	**46.0**	**2.5**	**60.0**	**29.0**	**3.5**	**80.0**	**40.0**
10	**5.0**	**100.0**	**57.0**	**3.0**	**80.0**	**34.0**	**3.5**	**80.0**	**40.0**
11	**5.0**	**100.0**	**57.0**	**3.0**	**80.0**	**34.0**	**3.5**	**80.0**	**40.0**
12	**5.0**	**100.0**	**57.0**	**3.0**	**80.0**	**34.0**	**3.5**	**80.0**	**40.0**
13	**5.0**	**100.0**	**57.0**	**3.0**	**80.0**	**34.0**	**3.5**	**80.0**	**40.0**
14	**5.0**	**100.0**	**57.0**	**3.0**	**80.0**	**34.0**	**3.5**	**80.0**	**40.0**
15	**5.0**	**100.0**	**57.0**	**3.0**	**80.0**	**34.0**	**3.5**	**80.0**	**40.0**
16	**5.0**	**100.0**	**57.0**	**3.0**	**80.0**	**34.0**	**3.5**	**80.0**	**40.0**

Recommendations for DEER Prototype models

Based on the above discussion, it is recommended that DEER prototype models adopt the following HVAC sizing and oversizing methodologies:

- **Residential prototype models:** It is recommended to avoid using the hard-sized approach. Instead, utilize EnergyPlus for initial HVAC sizing. Following this, apply ACCA Manual J for oversizing and ACCA Manual S for system selection to ensure optimal performance and capacity.
- **Commercial prototype models:** It is advised not to apply a double oversizing factor to the HVAC systems. Instead, use the recommended sizing factors of 1.25 for heating and 1.15 for cooling. This approach aligns with standard industry practices and ensures appropriate system sizing without excessive oversizing.