

Extending ORNL HPDM Capabilities for Design and Optimization of New Refrigerant Blends – FY18 3rd Quarter (Go/No-Go) Milestone Report: A Trial Version Published Online



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06/30/2018

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**BTO Project 3.2.2.26
FY18 3rd Quarter Milestone Report**

**Extending ORNL HPDM Capabilities for Design and Optimization of New
Refrigerant Blends – FY18 3rd Quarterly Milestone: A Trial Version
Published online for Modeling and Design AC Units Using Low GWP
Refrigerants**

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A Trial Version Published Online for Modeling and Design AC Units Using Low GWP Refrigerants (Go/No-Go Milestone)

Executive Summary

Based on exhaustive literature survey, we updated the DOE/ORNL HPDM to include most up-to-date heat transfer and pressure drop correlations suitable for modelling low GWP HFO blends and built up a comprehensive refrigerant property database including all the emerged HFO refrigerants. The upgraded HPDM has been released online, containing a desktop version for free download. The new release includes five system examples of room and commercial air conditioner (AC) units, which facilitates modelling and designing AC units using low GWP refrigerants. Geometry and configurations of the units were obtained from ORNL's low-GWP refrigerant drop-in investigations [1] [2]. The published models have been calibrated to match the measured data. The new public-domain, free-to-use tool will help the US industry design their AC units using the new refrigerants and shorten the learning curve.

A Trial HPDM Version Published Online for Modelling and Design Air Conditioner Units Using Low GWP Refrigerants

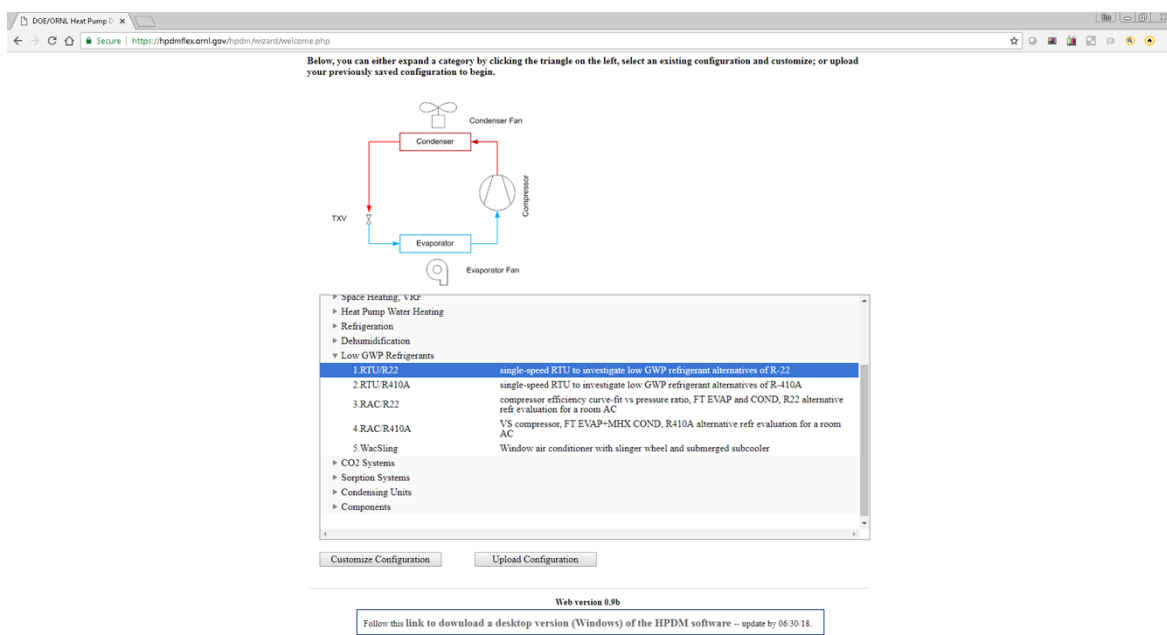


Figure 1. New online release including five AC systems using low GWP refrigerants and a desktop version for free download.

After upgrading heat transfer and pressure drop correlations up-to-date and suitable for low GWP HFO blends, and adding the low GWP refrigerant properties, we released the new HPDM model online at <https://hpdmfex.ornl.gov>. A new category of "Low GWP refrigerants" was added as shown in Figure 1.

It comprises five AC units, i.e. a packaged rooftop air conditioner (RTU) originally design for R-22 and an RTU originally design for R-410A, a room air conditioner (RAC) originally design for R-22, an RAC originally designed for R-410A, and a window air conditioner originally designed for R-410A. We reused the information from our previous low GWP refrigerants drop-in studies. The unit geometry inputs and configurations of the room air conditioners were obtained from Abdelaziz et al. (2015) [1], and details of the RTUs were obtained from Abdelaziz et al. (2016) [2]. The window air conditioner (WAC) was a GE unit, which was modified for our propane WAC development. The published system examples have been calibrated to match the measured data.

The five system examples allow users to vary the refrigerant type in a drop-down list including all the low GWP refrigerants, e.g. DR-22, ARM-22a, ARM-20b, etc. The compressor model allows the user to scale the compressor performance using a compressor map developed for a baseline refrigerant, or directly input the compressor volumetric and isentropic efficiencies or curve-fit functions versus the pressure ratio.

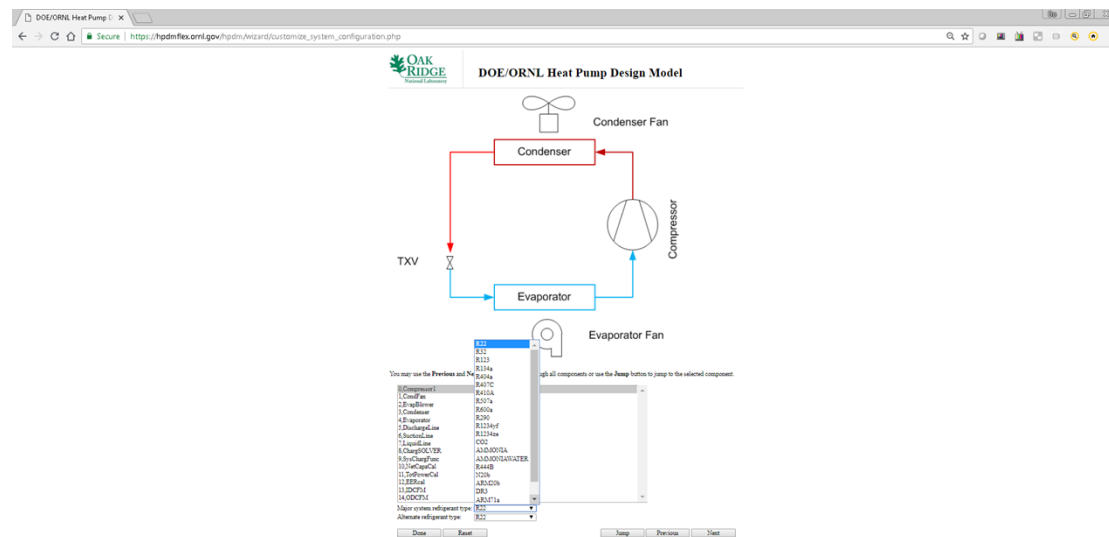


Figure 2. Drop-down list including low GWP refrigerants for system modeling in the HPDM online version. Additionally, a download link is given at the bottom of the webpage and allows the user to obtain a free desktop version. The desktop version includes all the HPDM executables, property files, and the published system examples for the user to run simulations at his personal computer. It also provides an Excel Add-In interface to help the user design new AC units.

References

- [1] Abdelaziz, O. A., Shrestha, S., Munk, J., Linkous, R., Goetzler, W., Guernsey, M., and Kassugaet, T., 2015, "Alternative Refrigerant Evaluation for High-Ambient-Temperature Environments: R-22 and R-410A Alternatives for Mini-Split Air Conditioners", ORNL/TM-2015/536, <http://info.ornl.gov/sites/publications/Files/Pub59157.pdf>

- [2] Abdelaziz, O. A., Shrestha, S., Shen, B., Elatar, A., Linkous, R., Goetzler, W., Guernsey, M., and Bargash, Y., 2016, "Alternative Refrigerant Evaluation for High-Ambient-Temperature Environments: R-22 and R-410A Alternatives for Rooftop Air Conditioners", ORNL/TM-2016/513, <http://info.ornl.gov/sites/publications/Files/Pub69980.pdf>.