

Two-phase Heat Transfer and Pressure Drop Characterization of Low Global Warming Potential Refrigerants, and Implementation on Heat Exchangers and System Models



Award No: EE0010919

Lead Organization: Air Conditioning, Heating and Refrigeration Technology Institute (AHRTI)
Partner Organizations: Oak Ridge National Laboratory (ORNL), Air Conditioning, Heating and Refrigeration Institute (AHRI)
Principal Investigator (PI): Xudong Wang (AHRTI), **PI Email:** xwang@ahrinet.org
Partner Investigators: Samuel Yana Motta (ORNL), Brian Fricke (ORNL), Kashif Nawaz (ORNL)

Background / Problem

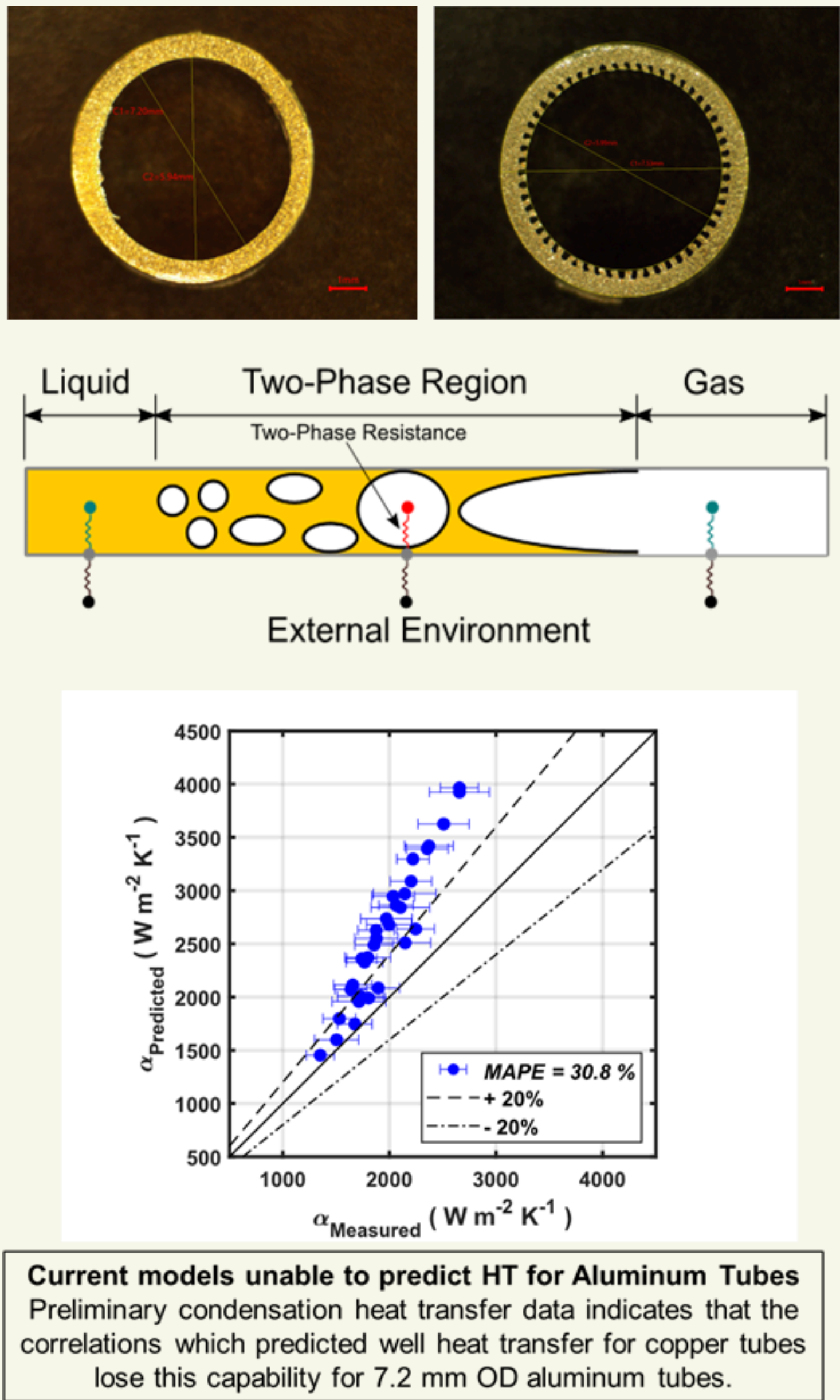
The American Innovation and Manufacturing (AIM) Act of 2020 targets an 85% hydrofluorocarbon (HFC) phasedown by 2035. Lower global warming potential (GWP) refrigerants can help meet this target.

Manufacturers will need to redesign heat exchangers to be compatible with these new low GWP refrigerants. This redesign will require accurate refrigerant heat transfer and pressure drop correlations.

Adjustment of existing correlations or development of new correlations is needed for low GWP refrigerants.

Objective

- Characterize the heat transfer and pressure drop of next generation refrigerants having GWP less than 150.
- Overcome hurdles of implementing environmentally friendly refrigerants in HVACR products by providing accurate refrigerant heat transfer and pressure correlations.



Impact

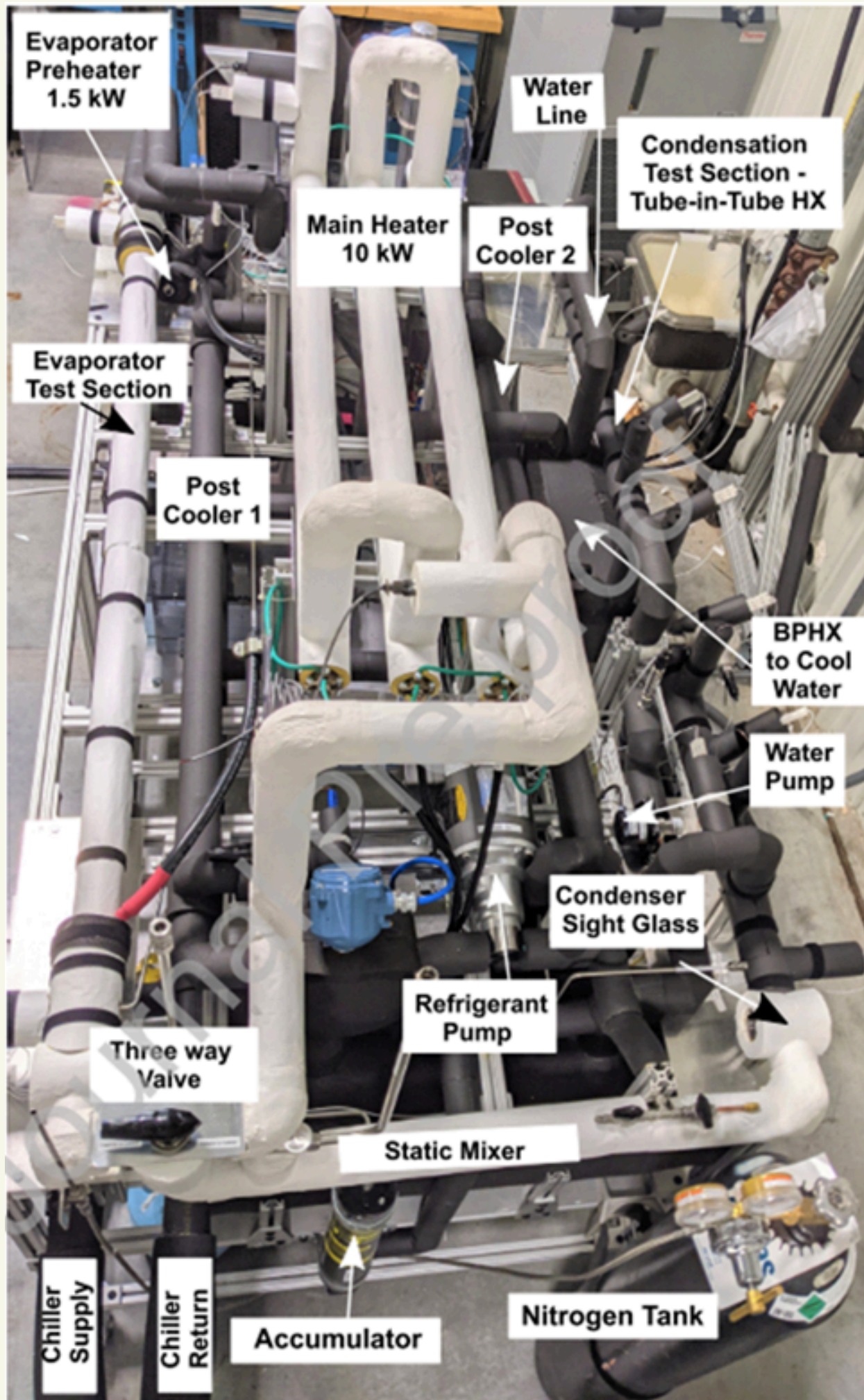
- This project will expedite the implementation of lower GWP refrigerants in the US market.
- Accurate correlations for designing and optimizing heat exchangers would avoid any duplication of effort in the industry.
- The knowledge gained will help domestic manufacturers develop competitive products in domestic and foreign markets.
 - These lower GWP refrigerants are expected to match or exceed the performance of high GWP HFC refrigerants.
- The outcomes from this research will provide manufacturers with knowledge to optimize their products and reduce product costs.

Approach

The overall scope of the project includes experimentally develop accurate heat transfer and pressure drop correlations for the new lower GWP refrigerant blends. The measured data will be used to validate/calibrate the existing correlations or to develop new correlations for lower GWP refrigerants.

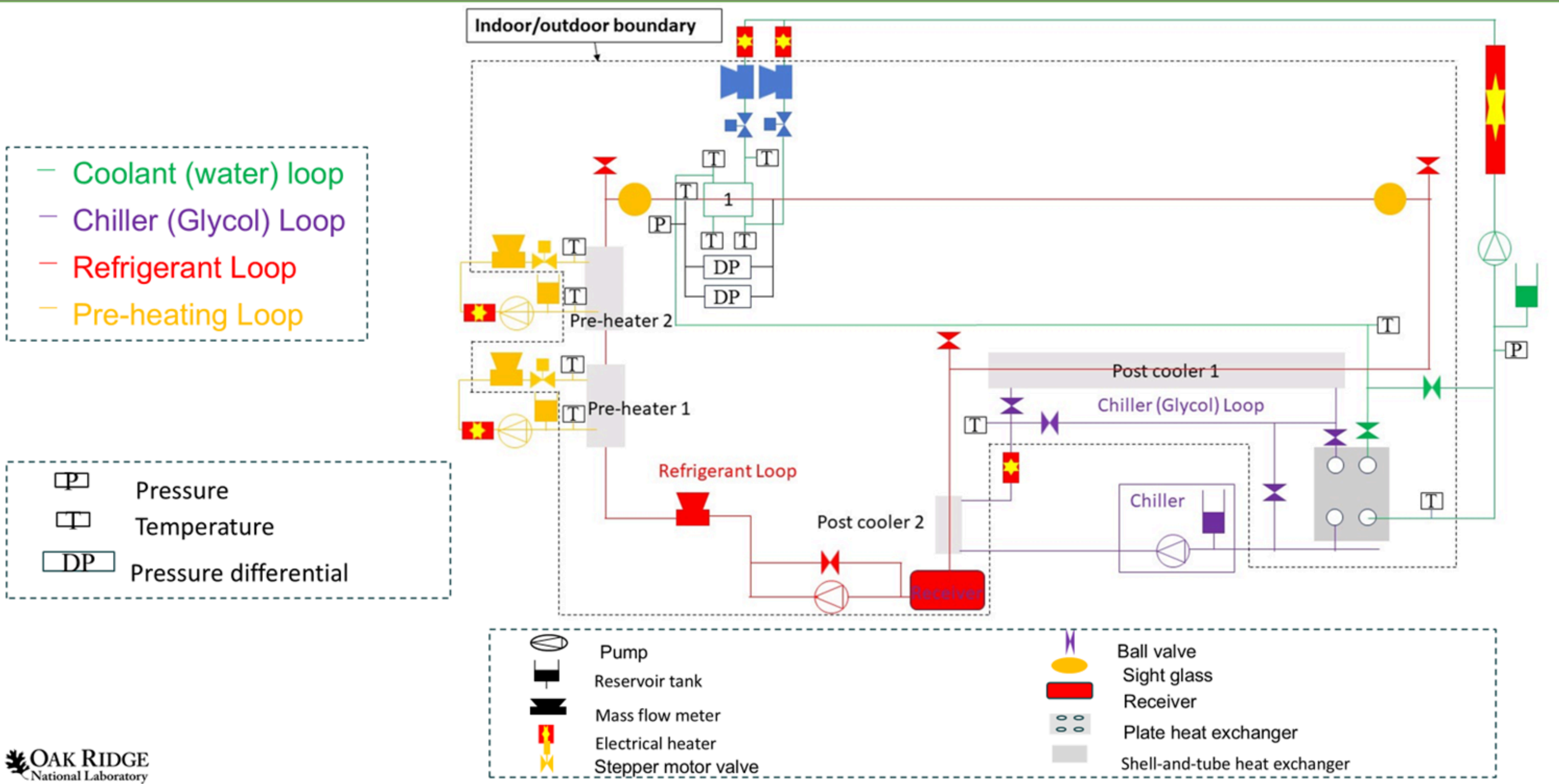
The first step in conducting the project is to develop a list of candidate alternative refrigerants and tube configurations by surveying the industry. Upon the completion of selecting lower GWP refrigerant candidates, the project will then undergo its experimental stage that will be primarily undertaken by ORNL team with the support from AHRTI industry members. The project will consist of the following key components:

- Test rig design and construction.
- Heat transfer and pressure drop experiments.
- Update of heat transfer and pressure drop correlations as well as system modeling tools.
- Final report and publications.



Test rig examples [Source: DE-EE0008406]

Schematic of a typical short length test section



Progress and Future Work

- This project has just begun. AHRTI is in the process of selecting builders for the test rig.
 - After the test rig is built, next steps will be to evaluate the test rig, commission the test rig, and then begin testing.
- Once the tests produce accurate correlations, AHRTI will disseminate the results to the industry to optimize products.