SMALL BUILDING HVAC:

RETROFIT SOLUTIONS

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Introduction

Many of the small buildings on the UC Davis Campus operate outdated, energy-inefficient HVAC systems. These buildings often rely on natural gas and oversized cooling units, resulting in higher energy use and cost. Thus, there is an opportunity to establish a modern precedent of an improved, *standardized* HVAC redesign for small-to-medium buildings on campus.

The Energy Conservation Office (**ECO**) has a Heat Recovery Unit (**HRV**) that is currently not in use. In an effort to improve building efficiency, ECO would like to install this state-of-the-art system in a small building on campus. Two approaches can be used to install a HRV:

- Install new ducts in the building alongside the existing heating and cooling ducts.
- Retrofit the HRV unit to the existing ductwork and install a ductless heating and cooling system.

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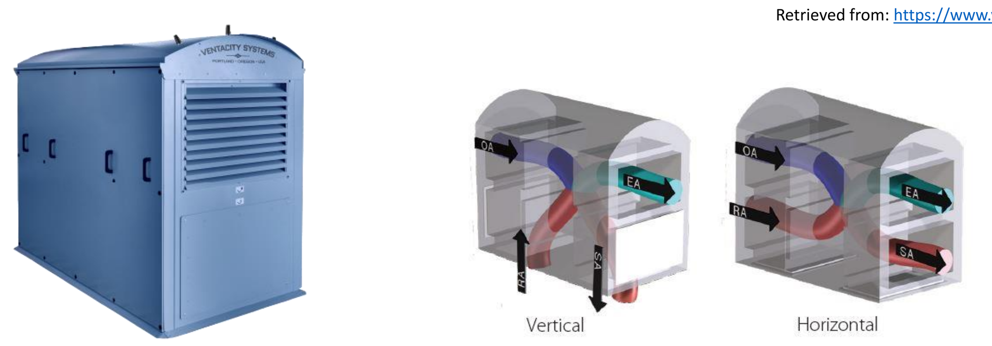


*The Surplus HRV unit uses a heat exchanger to precondition outdoor air with the exhaust of the inside air.

Objectives

Using the second approach mentioned above, we set out to design a retrofit using a Variable Refrigerant Flow (**VRF**) system for heating and cooling. Three buildings were evaluated as candidates for retrofit.

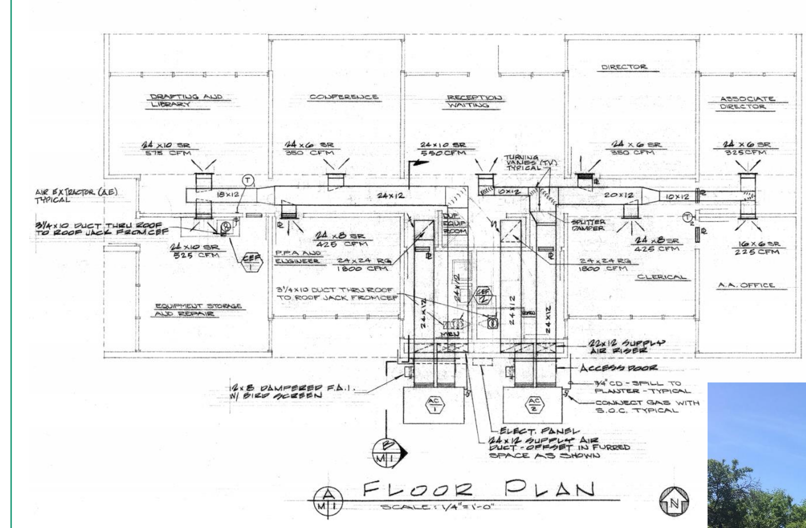
Pressure loss from ductwork, and heating and cooling loads were determined for each building to ensure they were feasible candidates.

Following the technical assessment, an evaluative matrix was used to determine the best candidate for the retrofit. With the help of ECO, we created a detailed profile of selection criteria to properly assess potential small buildings.

	Ag Field Station	University House	Music Annex	Weight
Criteria:				
Existing Infrastructure				3
Potential Energy Savings				3
Cost of Install				2
Impact of Retrofit				1
Size of Unit Required (Energy)				1
Learning Outcomes/Scalability				2
Building Usage				1
Building Life Expectancy				2
Showcase Ability				1
Existing Equipment Life Expec.				1
Totals:	**0**	**0**	**0**	

Methods

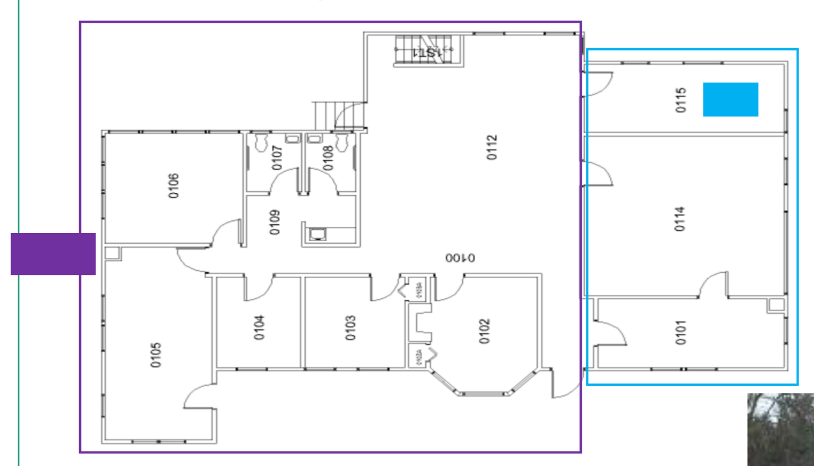
Ag Field Station



Retrieved from: *FacilitiesMap*

- YEAR BUILT: 1973
- ASF: 2200
- USAGE: Office/Admin
- HEATING: Natural Gas Furnace
- COOLING: 2 Outdoor A/C Units

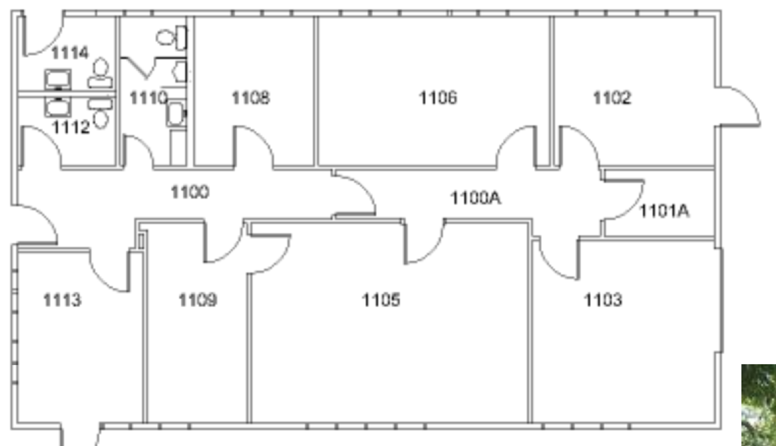
University House



Retrieved from: *FacilitiesLink*

- YEAR BUILT: 1908
- ASF: 2,396
- USAGE: Office / Study
- HEATING: Natural Gas Furnace
- COOLING: 2 Outdoor A/C Units

Music Annex



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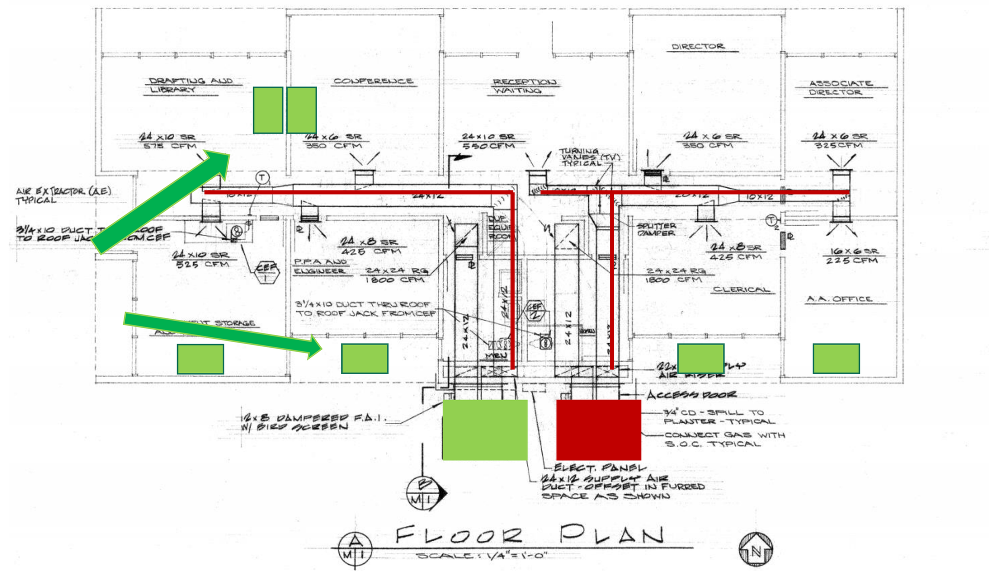
- YEAR BUILT: 1950
- ASF: 1244
- USAGE: Office/Admin
- HEATING/COOLING: Ducted Heat Pump
- Evaporator indoor
- Condenser outdoor

Results



- Estimated Cooling Load: **~66 kBtu/h**
- Estimated Heating Load: **~95 kBtu/h**
- VRF System: **~$16,000**
  - **8 ton** outdoor unit
  - 9 indoor units
- Labor Costs: **~$65,000**
- Potential Energy Savings: **10.3 kBtu/ft2 yr**

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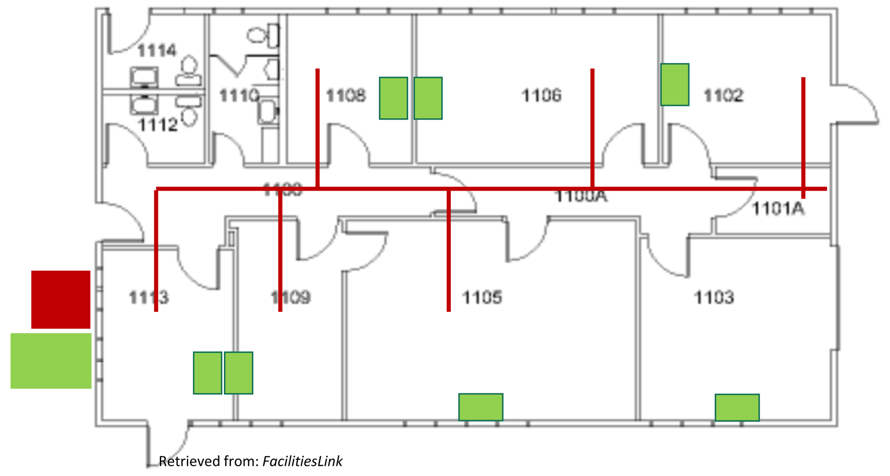
- Estimated Cooling Load: **~85 kBtu/h**
- Estimated Heating Load: **~95 kBtu/h**
- VRF System: **~$16,000**
  - **8 ton** outdoor unit
  - 9 indoor units
- Labor Costs: **~$80,000**
- Potential Energy Savings: **11 Btu/ft2 yr**



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- Estimated Cooling Load: **~37 kBtu/h**
- Estimated Heating Load: **~42 kBtu/h**
- VRF System: **~$12,000**
  - **6 ton** outdoor unit
  - 7 indoor units
- Labor Costs: **~$36,000**
- Potential Energy Savings: **5 kBtu/ft2 yr**

Conclusions

Based on the criteria, University House is considered the best candidate for the retrofit. Alongside ECO's office, it has the potential to serve as a *model* for retrofitting small buildings on campus.

To maximize energy savings at University House, ECO may consider installing insulation to minimize loads for the VRF system.

	Ag Field Station	University House	Music Annex	Weight
Criteria:				
Existing Infrastructure	2	3	1	3
Potential Energy Savings	2	2	1	3
Cost of Install	2	2	1	2
Impact of Retrofit	2	3	2	1
Size of Unit Required (Energy)	2	2	3	1
Learning Outcomes/Scalability	2	3	1	2
Building Usage	n/a	3	2	1
Building Life Expectancy	1	3	2	2
Showcase Ability	2	3	1	1
Existing Equipment Life Expec.	2	2	2	1
Totals:	**30**	**44**	**24**	

References

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