Attachment 5

Steamboat Fire Station and City Hall
HVAC Systems Comparison Matrix

8/17/2022

Tag	System Type	Description	Impact Considerations: First Cost	Owner	Architectural	Equipment	Energy Efficiency 0-10	Lifespan (Years)	Notes
[0]	Packaged DX/Gas Rooftop Air Handlers	This option utilizes conventional rooftop units with duct distribution through vertical shafts.	1. The most economical of the options.	1. Central location for most maintenance. Easy to perform maintenance without disrupting operations.	1. [1], [2], [3] require the most shaft space of the options.	1. Central equipment for service and replacement.	~5-6	RTU: 15 Boilers: 25 Pumps: 10-20	Allows for the Fire Statoin and City Hall to be on separate systems for scheduling and separatoin of energy use.
CH	$ 1,443,780	DX Cooling with gas heat	2. Large vertical shafts required as all air is routed down from roof.		2. Boiler room required.	2. Packaged DX typically has the highest energy use. We will need to have hot water reheat at VAV boxes.			Note that a few manufacturers offer evaporative condensing on packaged units and could also consider aftermarket evaproative technology.
FR	$ 2,760,300	A boiler plant is required for VAV reheat, app bay radiant floor, and snowmelt.	3. Simple OA system using RTUs.						
	$ 4,204,080		4. Simple Economizer system with RTUs.						
[1]	Energy Recovery RTU Heat Pump ERVs	This option utilizes packaged heat recovery heat pump rooftop units.	1. The second most economical of the systems as [2] and [3] still require a DOAS unit for ventilation.	1. Central location for most maintenance. Easy to perform maintenance without disrupting operations.	1. Requires the most shaft space of the options.	1. Central equipment for service and replacement.	~6 to 7	RTU: 15 Boilers: 25 Pumps: 10-20	Allows for the Fire Station and City Hall to be on separate systems for scheduling and separation of energy use.
CH	$ 1,647,794	DX cooling, Heat pump + supplementary hydronic Heat	2. Large vertical shafts required as all air is routed down from roof.		2. Boiler room required.	2. We will need to have hot water reheat at VAV boxes.			
FR	$ 3,067,000	A boiler plant is required for VAV reheat and supplementary RTU heat.	3. Simple OA system using RTUs.						
	$ 4,714,794		4. Simple Economizer system with RTUs.						
[2]	Two-pipe Heat Pump System	This option utilizes heat pumps distributed throughout the building. Condenser water is piped to the various units.	1. Reduced cost compared to Option [2a], but higher than [1].	1. Vertical shaft space reduced vs. [1].	1. Potential noise issues with heat pump compressors throughout buildings.	1. Requires more overall/distributed maintenance.	~7 to 8	Heat Pumps: 15 Boilers: 25 Pumps: 10-20 Cooling Tower: 20	Commonplace for fire stations and provides additional longevity over RTU options.
CH	$ 1,989,666	Cooling tower and boiler plant required.	2. Simple/shallow ductwork.	2. Distributed maintenance.	2. Still requires vertical shafts for ventilation air from DOAS unit.	2. Condenser/heating water plants will require make up water and ongoing water/chemical maintenance.			Only cost effective if both buildings are served by common systems (with below grade piping between).
FR	$ 3,452,830	Ventilation is provided by a rooftop ERV Heat pump DOAS unit with supplemental hydronic heat.	3. Dedicated OA systems are required.		3. Larger mechanical room for additional condenser water system components.				This system is in use at Eagle River Fire and Edwards Fire.
	$ 5,442,496		5. Requires hydronic central plant (including cooling tower, boilers, pumps, piping, controls, and accessories).						
			6. Higher electrical distribution cost than RTU option for heat pump units and central plant equipment.						
			7. Water side economizer.						
[2a]	Geothermal System	This option utilizes heat pumps distributed throughout the building. Geothermal water is piped to the various units.	Highest cost option due to the wellfield boring costs.	1. Vertical shaft space reduced vs. [1].	1. Potential noise issues with heat pump compressors throughout buildings.	1. Requires more overall/distributed maintenance.	~9 to 10	Heat Pumps: 15 Boilers: 25 Pumps: 10-20	Commonplace for fire stations and provides additional longevity over RTU options.
CH	$ 2,340,166	Geothermal and Boiler plants required.	2. Simple/shallow ductwork.	2. Distributed maintenance.	2. Still requires vertical shafts for ventilation air from DOAS unit.	2. Condenser/heating water plants will require make up water and ongoing water/chemical maintenance.			Only cost effective if both buildings are served by common systems (with below grade piping between).
FR	$ 3,756,937	Ventilation is provided by a rooftop ERV Heat pump DOAS unit with supplemental hydronic heat.	3. Dedicated OA systems are required.		3. Larger mechanical room for additional geothermal water system components.				
	$ 6,097,103		5. Requires hydronic central plant (including well field, boilers, pumps, piping, controls, and accessories).						
			6. Higher electrical distribution cost than RTU options for heat pump units and central plant equipment.						
			7. Water side economizer.						
[3]	Variable Refrigerant Flow	This option utilizes variable refrigerant flow (VRF) systems comprised of large outdoor heap pump units on the roof coupled with fan coils in each zone.	1. Similar shaft requirements as [2] and [3].	1. Vertical shaft space reduced vs. [1].	1. More rooftop equipment.	1. Requires more overall/distributed maintenance.	~7-8	VRF: 15 Boilers: 25 Pumps: 10-20	Some concern about operation with low ambient temperatures and local snowfall.
CH	$ 1,925,794	A boiler plant is required for snowmelt, radiant, and DOAS heat.	2. Simple/shallow ductwork.	2. Distributed maintenance.	2. Still requires vertical shafts for ventilation air from DOAS unit.	2. Additional tooftop space required for condensing units.			
FR	$ 3,375,600	Ventilation is provided by a rooftop ERV Heat pump DOAS unit with supplemental hydronic heat.	3. Dedicated OA systems are required.		Reduced mechanical room space required.				
	$ 5,301,394		4. Higher electrical distribution cost than RTU option for condensing and fan coil units.						

General Notes:
1. All options require a boiler plant to meet code and allow for app bay radiant and snowmelt.