APPENDIX B - ENERGY AUDIT

EXECUTIVE SUMMARY

According to the United States (U.S.) Energy Information Administration 40 percent of the energy consumed in the U.S. was consumed by residential and commercial buildings in 2018. These buildings consumed about 40 quadrillion British Thermal Units (BTUs) in 2018. The U.S. Energy Administration projects that global energy consumption by buildings will grow by more than 2 percent per year worldwide. The higher consumption is partially due to the projection for total world population growth of more than 2.7 billion people by 2060 according to "Achieving Zero – Architecture 2030."

Studies by Lawrence Berkeley National Laboratory have proven that the most effective and immediate reduction in energy consumption and carbon emissions results from optimizing existing equipment and systems. Businesses in the U.S. can eliminate about 13 percent of the energy consumed by their facilities by evaluating existing equipment and optimizing its operation.

As part of the Rogue Valley International – Medford Airport (MFR) Master Plan effort, the terminal building located at 1000 Terminal Loop Parkway underwent an energy audit. The overview of the Energy Audit includes the following sections:

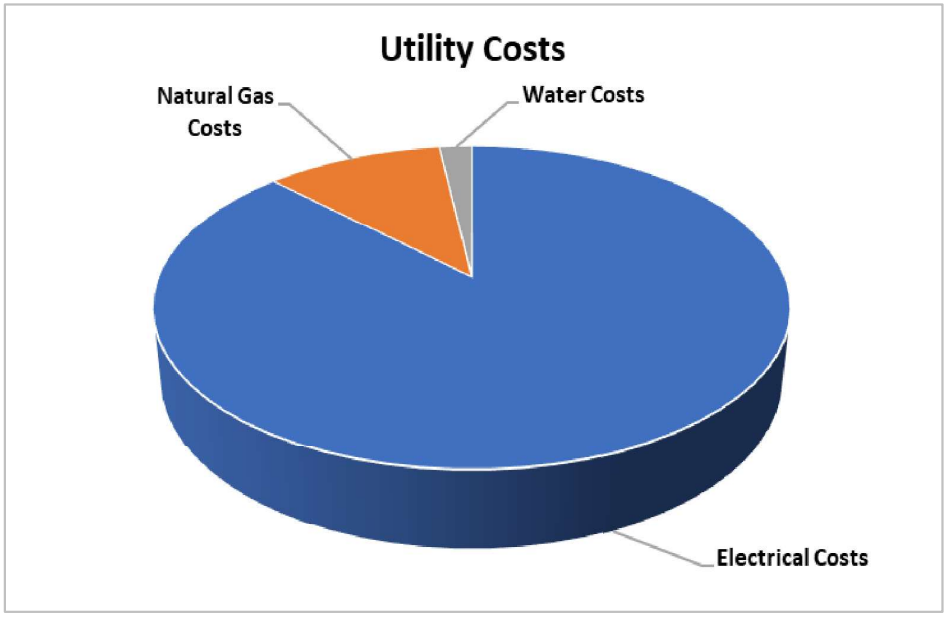
- Energy Analysis
- Summary of Systems
- Identified Measures and Recommendations
- Long Term Recommendations
- Energy Incentive Opportunities

Approximately 95 percent of the energy consumed on site of the MFR Airport Terminal Building is electrical energy. This consumption profile is partially due to the constant lighting load and the needed electric Direct Expansion (DX) cooling provided.

Mead and Hunt conducted a site survey of the facility and provides this overview of the facility's existing conditions. The survey was conducted at MFR on September 18 and 19, 2019. Prior to the site survey, a meeting took place with the Director of Operations for MFR. Operations Staff expressed two main concerns to be investigated during the site visit:

- Extensive air flow between the entrance doors and boarding doors at high traffic times.
- Extensive temperature fluctuations due to the entire space being served by one constant volume air conditioning (AC) unit located in the administration area.

Figure B-1: Rogue Valley International Medford Airport (MFR) Utility Profile



The survey effort consisted of investigating the conditions above, reviewing existing systems, evaluating systems operation, and evaluating use of the spaces within the facility. Numerous members of the MFR Operations and Maintenance (O&M) Staff participated in the audit survey. The survey identified the following items that will result in immediate improvement in air quality within the facility and maximize energy efficiency. The improvement measures are shown in **Table B-1** and are identified further in this report.

Table B-1: Facility Improvement Measures

Measure	Equipment	Estimated Savings	Implementation Cost	Payback (yrs.)
#1	Energy Recovery Ventilator Units	$ 17,872	$ 9,000	0.5
#2	AC Units	$ 168,177	$ 37,500	0.2
#3	AC 15, 16, 17, and 18	$ 5,097	$ 6,000	1.2
#4	Ticketing Lighting	$ 2,641	$ 10,880	4.1
#5	Wall Lighting	$ 875	$ 9,520	10.89
#6	Boarding and General Lighting	$ 1,651	$ 40,061	24.3
#7	Lighting Control	$ 3,856	$ 5,000	1.3
#8	AC 18	$ -	$ 5,000	N/A
#9	Retro-Commissioning	13%	$ 25,000	1.0

Energy Calculations are based on values reflected on energy bills; $0.088/kWH & $0.89/therm.

Implementation of these items is recommended as soon as possible to improve the temperatures and pressures within the terminal building while greatly reducing energy consumption.

ENERGY ANALYSIS

Within the past two years there has been an adjustment the receiving and filing of energy bills for the county. JC Finance receives the Avista (Gas) and Pacific Power utility bills serving MFR. Due to this adjustment, energy consumption information prior to 2017 is unobtainable. An energy analysis included energy consumption data from June 2018 to June 2019 (**Table B-2**).

Table B-2: Annual Energy Consumption

Facility Address	Area (sf)	Electric* Usage (kWh/yr)	Natural Gas* Usage (therm/yr)	Energy Use (kBTU/sf)	Energy Cost ($/yr)	Energy Cost ($/sf/yr)
1000 Terminal Loop Parkway	75,695	1,940,000	16,184	109	$188,760	$2.49

Note: *Readings of meters: 75455700, 83525385, and 09852241
*kilowatt hour (kWh)
* unit of heat energy equal to 100000 British thermal units.

Source: Energy Star – Portfolio Manager

The facility Site Energy Use Intensity (SEUI) for the MFR Terminal Building was determined to be relatively low at 108.8 kBTU/SF. As a comparison, the average terminal building SEUI is 152 kBTU/SF as identified in the 2012 Commercial Buildings Energy Consumption Survey. The following report identifies some observations resulting in lower than average energy consumption.

The national average for all building types is a SEUI of 81 kBTU/SF, although airport terminal buildings commonly have higher energy consumption per square foot as the result of being occupied 24 hours per day and the ventilation requirements associated with the number of occupants utilizing the facility on a daily basis.

SUMMARY OF SYSTEMS

Mechanical System Summary

The MFR Terminal Building was constructed in 2008 and opened in early 2009. The facility was designed per the 2003 International Building Code. The systems incorporate constant volume AC units served by Energy Recovery Ventilators (ERVs) to increase energy efficiency. The 10-year-old systems are original to the construction of the facility. These units have an expected life expectancy of 20-25 years. With appropriate maintenance the AC systems should provide another 10 years of reliable service.

The main facility is served by 18 AC units located on the roof, and three additional units mounted at grade serve the baggage areas. A majority of the AC units on the roof (15 of 18) have an associated ERV to temper the outside air during minimum outside air conditions. Each unit is controlled by a dedicated thermostat located in the associated zone (Example: Zone 18 is served by AC 18).

Zone 18 is the administration area and consists of common areas and individual offices on the same zone. The offices are occupied regularly and see drastic fluctuations in temperature in comparison with the much larger adjacent spaces. The ventilation ductwork to the offices has been terminated and individual heating cassettes installed in each office. Heating is provided by a condensing unit located on the roof.

Figure B-2: Air Conditioning Unit Zones of Control- First Floor

Figure B-3: Air Conditioning Unit Zones of Control- Second Floor

Electrical System Summary

The terminal building is naturally made up of three general areas, ticketing and outbound baggage claim, boarding, and “back of the house” type spaces. The facility is mostly illuminated via the original lighting fixtures installed in 2008 that are 11 years old. These fixtures are nearing the end of their useful life. Replacement should take place within the next five years to prevent multiple fixture failures.

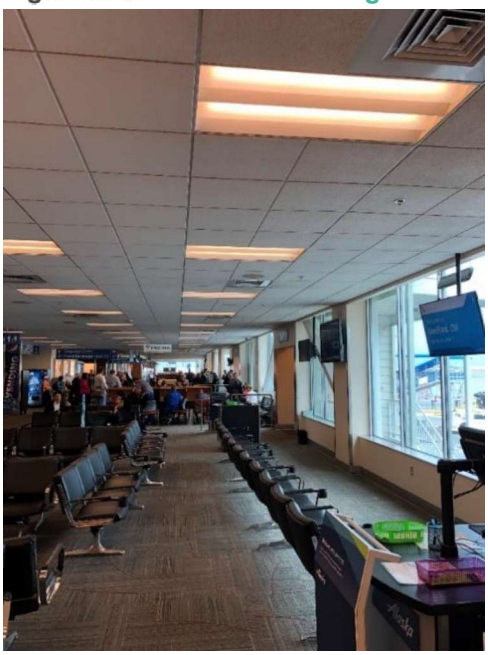
Metal halide fixtures currently illuminate the ticketing and baggage claim areas. There are 16 400-watt (W) metal halide fixtures providing the general lighting within the ticketing and baggage claim areas (See **Figure B-4**). In addition, 14 metal halide fixtures at 250W each are washing the walls of the space.

Figure B-4: 400W Metal Halides in Ticketing and Baggage Claim

The facility boarding area and other customer areas are illuminated with energy efficient T5 fixtures with on/off daylight harvesting control. At the time of the site visit all boarding lights were “On” and we did not witness lights cycling on and off. Large open areas are commonly susceptible to nuisance switching called “cross-talk” when on/off daylight harvesting is implemented in open spaces.

Janitors closets and back of the house areas are currently illuminated with T8 fixtures. The lights serving the back of the house are controlled via switches.

Figure B-5: T-5s in Boarding



IDENTIFIED MEASURES AND RECOMMENDATIONS

Mechanical Survey Results

Code Required Adjustments

The energy audit survey identified some key factors that are resulting in the observed reduced energy use from June 2018 to June 2019. The AC Units providing ventilation to the facility are currently in "Auto" mode and only operate when heating or cooling is required in their designated zone. When heating and cooling is not needed the units shut down. The facility is required by the 2003 International Building Code to deliver ventilation to the spaces anytime the spaces are occupied. Due to the nature of this facility, it is considered continuously occupied therefore the system fans should operate 24 hours a day, seven days a week.

Code Recommendation: Place each AC Unit fan in the "On" mode for continuous ventilation as required by the 2003 International Building Code.

Measure #1: Activate ERVs

The ERV systems were found to be disabled. Each facility member interviewed while on-site expressed the "wind tunnel" effect when the ticketing doors and boarding doors are open simultaneously. During the interview with the staff they indicated the units were disabled as the result of the extensive amount of outside air being drawn into the facility through the front doors and the boarding doors. The air infiltration (wind tunnel effect) is partially due to the associated AC units shutting down as mentioned above. Disabling the ERVs disables the Outside Air (OA) fans within the ERV, which induces pressure drop on the AC supply fan causing a drastic decrease in air flow shown in **Figure B-6**. Un-tempered air enters the facility through the doors when opened causing temperature fluctuations within the facility.

Recommendation #1: Clean, replace the filters for, and enable the ERV Units. Activation of the ERV and associated fans will result in higher outside air flow and more stable building pressurization shown in **Figure B-7**

Figure B-6: Unit Operation in Current Condition

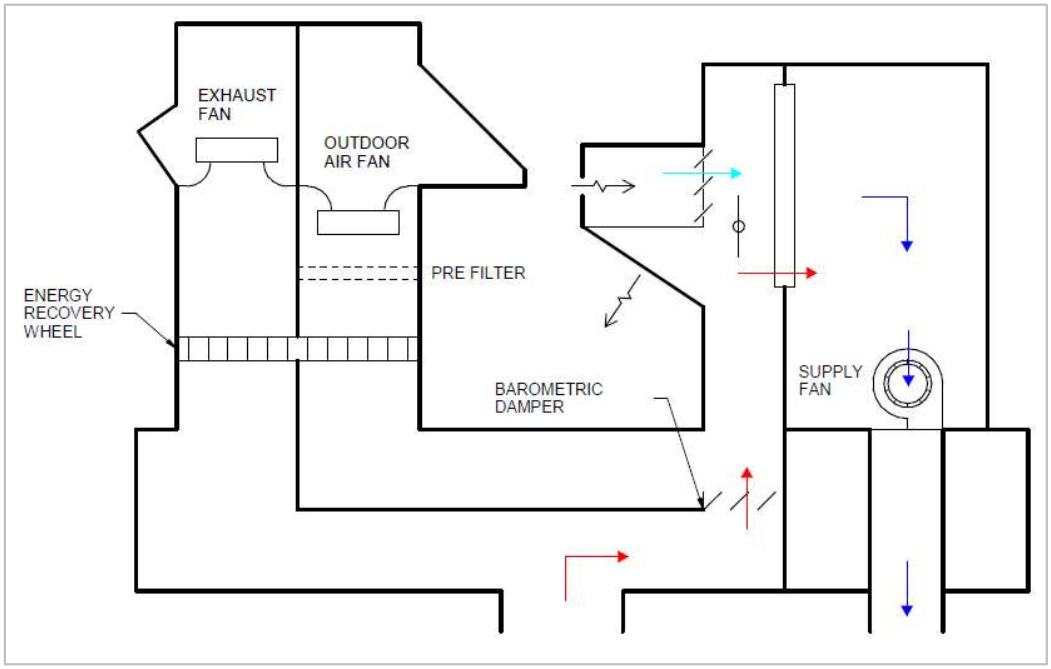
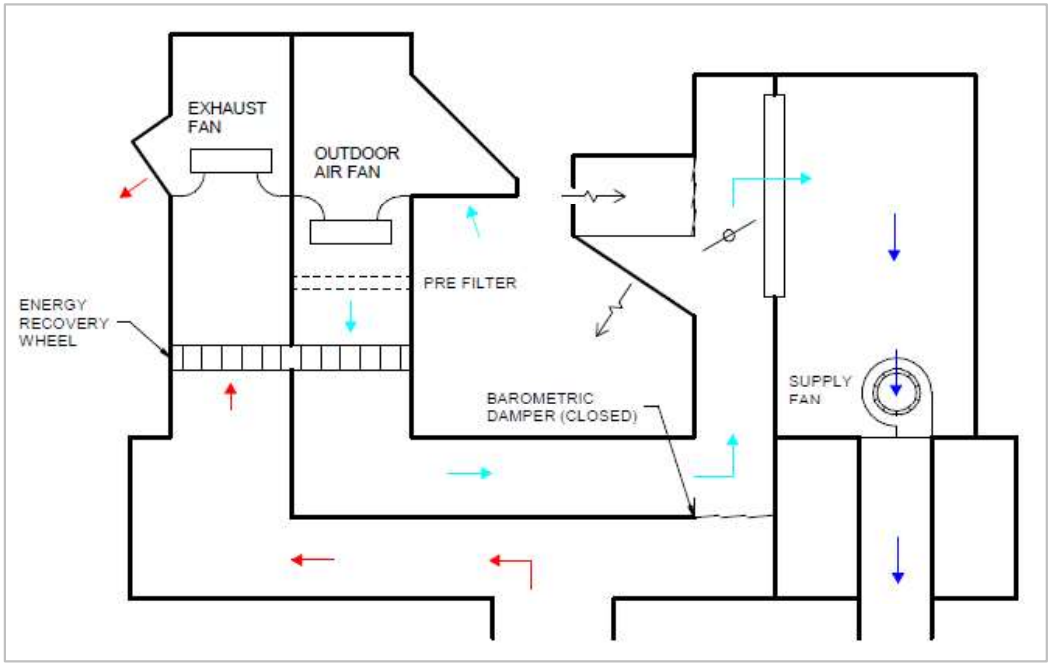


Figure B-7: Unit Operation in Recommended Condition



Measure #2: Verify Min OA and Economizer Modes

The outside air temperature in Medford is between 44°F and 64°F for more than 4,994 hours (out of 8,760 hours) every year according to the National Solar Radiation Data Base (NSRDB). During this time the AC units can be utilizing outside air for cooling instead of trying to mechanically cool the air returned from the space. This is called "economizing" or "free cooling." At the time of the site visit each of the AC units had its respective outdoor air dampers closed (or partially open) at the time the associated ERV was overridden to "off."

Recommendation #2: Request the local Carrier representative visit the site to update the control program in each AC unit and ERV back to the original design intent. This effort will also require a controls contractor and testing, and balancing contractor visit the site to verify the correct air flow when in minimum outdoor air condition.

Measure #3: Update Occupied and Unoccupied Modes

Once the unit is operational at all occupied times, incorporate space reset temperatures at all "unoccupied times." Currently the "Occupied" settings cool the space to 71°F and heat the space to 67°F.

Recommendation #3: During "Unoccupied" times, establish the unit cooling setpoint at 78°F and the heating setpoint at 65°F.

Measure #8: Reconnect Offices to AC 18

One of the original challenges MFR staff expressed is the concern related to AC 18 serving the entire administration area. The temperature in the offices fluctuates considerably as the common area temperature (location of the thermostat) remains constant. The ventilation serving each office has been terminated, and cooling is now provided by ceiling mounted cassettes via a roof mounted condensing unit.

Recommendation #8: Per 2003 International Building Code, ventilation is to be provided at all occupied times. The ductwork to each office should be reconnected to AC 18 as needed for ventilation. The cassettes in the ceiling can be used to provide supplemental heating or cooling when needed. If needed, relocate the thermostat controlling AC 18 to northeast office to ensure the unit controls respond to heating needs in the winter.

Measure #9: Retro commissioning

The operation of the AC units and ERVs at the time of the site visit was not in keeping with the intended design. Public terminal and transit facilities have an elevated energy consumption due to being occupied continuously. The costs associated with tempering the required ventilation air is considerable and can be minimized by effectively retro commissioning each AC and ERV.

Recommendation #9: Carry out retro commissioning for each AC unit and ERV upon completion of the ERV activation, the manufacturer inspection, and verification of outside air flow.

Electrical Survey Results

Measure #4 and #5: Replace 400W and 250W Metal Halide Lights

There are 16 metal halide fixtures of 400W each providing the general lighting within the ticketing and baggage claim areas shown in **Figure B-4** and 14 metal halide fixtures of 250W each washing the walls of the space. These fixtures are considerably less efficient and reject extensive amounts of heat to the space. The fixtures are original to the facility and nearing the end of their useful life.

Recommendation #4 and #5: Replace the metal halide fixtures within the next five years with the LED version of the lights or similar LED feature lights.

Measure #6: Replacement of T-5 and T-8 Fixtures

The facility boarding area and other customer areas are illuminated with energy efficient T5 fixtures with On/Off daylight harvesting control. The lights were primarily on during all times during the site survey however On/Off systems are susceptible to control challenges on partly cloudy days and days with varying outdoor conditions.

Janitors closets and back of the house areas are currently illuminated with T8 fixtures. The lights serving the back of the house are controlled via switches.

Recommendations #6: Update all lighting to LED fixtures to reduce energy consumption and minimize maintenance costs.

Measure #7: Introduce Lighting Controls

The facility currently has windows on the west and east exposure to provide natural daylight to the boarding areas. New photosensors located between 10’ and 15’ from the exterior windows can provide lighting control to maintain between 20 fc and 50 fc depending on the area. For example: 20 fc is appropriate for general seating however 50 Fc may be needed at the counter and boarding stations. Dimmable LED lighting fixtures will result in uniform light distribution maintained through various outdoor conditions.

Recommendation #7: Install photosensors in ticketing, boarding, and baggage claim to automatically dim the associated lighting to maintain a designated foot-candle level within the space. Many models of lights can be ordered with photosensors integral to the unit. These fixtures should be installed in areas stated above to reduce lighting when not needed. All back of the house spaces should have occupancy sensors installed in each space to ensure lighting is “off” when spaces are not occupied.

LONG-TERM RECOMMENDATIONS

The items listed in **Table B-2** will immediately reduce energy consumption. It is recommended that the following improvement measures be considered and budgeted for future capital improvement projects to yield even more benefits. These projects will convert a portion of the electrical energy reliance to other resources while increasing system efficiencies. It is recommended the following capital improvement projects be included in the MFR Master Plan:

- **Additional Photovoltaic Panels**: Designate square footage for additional photovoltaic cells on site. Possible locations for panels can be the drop off canopies at the entrance of the facility shown in **Figure B-8**.
  - Pacific Power currently offers incentives in the state of Oregon related to installation of photovoltaic panels.

Figure B-8: Entrance Canopies

Source: Jackson County

- **Hydronic Heating and Cooling:** Introduce radiant heating in the boarding areas and Administration areas for zone control. This will require hot water heating being added to the facility but will provide the specific areas the ability to heat when needed without affecting the RTU serving the adjacent spaces.
  - Geothermal heating systems should be considered for the long term due to the sustainable nature the system can provide for heating and cooling.
  - Geothermal systems normally have a 15-20-year payback and should be budgeted as a long-term viable replacement associated with the rooftop unit replacements when needed.
- **A Building Automation System:** The facility does not have a Building Automation System that can provide additional efficiencies and to reflect the operation of the facility. Without this visual aid reflecting system operation, the facility is difficult to maintain. Awareness of equipment failure is only possible as the result of complaints or by a staff member physically witnessing the equipment in a failed state.
- **Program separation between ticketing and boarding:** The facility is struggling with air infiltration due to the high volume of traffic through the entrance doors and boarding doors. This causes a what has been described as a wind tunnel effect through the facility.
  - The recommendation is to make a physical separation at the security checkpoint to provide an air barrier.

ENERGY INCENTIVE OPPORTUNITIES

According to Energy Trust of Oregon and Pacific Power multiple incentives are available on an annual basis. The list below identifies incentives provided by Pacific Power.

Recommendations include MFR to contact Pacific Power regularly to discuss energy incentives and opportunities throughout each program year.

- **LED Lighting:** Retrofitting to LED lamps can be very cost effective when paired with a cash incentive as offered through Pacific Power. The current incentive is $2-$13/lamp.
- **Lighting fixture updates:** Projects to update interior lighting fixtures to LED can be supported by an existing incentive of $15-$40/fixture.
- **Photo-Voltaic Opportunities:** Pacific Power provides a $0.20/watt - $0.35/watt incentive for projects up to 250 kW. The campus has other photo-voltaic panels on-site and could add more panels at the entrance canopies or other locations on-site.
- **Kitchen Equipment:** Incentives are available for electric griddles, combination ovens, fryers, steam cookers, and ventilation hoods. (Although kitchen equipment can result in higher than necessary energy costs, the kitchen is a tenant in the facility and was not included in this audit.)

The facility currently is not heated via hot water systems, but if the facilities grow, the addition of hot water heating for the boarding areas and administration areas is recommended. Incentives are available for $8-10/kBTU/h.

The rooftop AC units are 11 years old and should not need to be replaced for another 10 years however the facility should start budgeting the replacement of these units as soon as possible. In the event a unit needs to be replaced with the next 10 years the staff should utilize incentives available through Pacific Power. Pacific Power currently has incentives for replacement rooftop units with economizer controls. The related incentive is $29-$100/ton of cooling.

[THIS PAGE INTENTIONALLY BLANK]