DRAFT Feasibility Assessment of Biomass Heating and Cooling at Plumas NF Supervisor's Office

Quincy, California

July 2013

Prepared for:
Plumas National Forest
US Forest Service

On behalf of:
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Quincy Supervisor's Office: Existing Heating Systems

The USFS Quincy Supervisor's Office is a combined office/equipment maintenance complex with multiple buildings located at 159 Lawrence Street, Quincy, California. A total of nine buildings were toured on June 24, 2013, including: Main Office (building #2000); Dispatch (#2301); Maintenance Garage (#2101); Garage/Vehicle Wash (#2100); Workshop/Engineering (#2300); Storage (#2202); Warehouse (#2201); Engineering (#2200); and Natural Resources Office (#2001).

Main Office (#2000)

The Main Office is a large building with 2 stories on its west wing and a single story and basement on its east wing. The east wing has three identical Lennox Elite Series oil-fired furnace/DX split systems fired by Lennox AFII-150 oil burners in its basement boiler room, each heating one of three zones across the wing that is controlled by its own thermostat. Each furnace is also connected to a Bryant air conditioning unit located outside the building. One of the furnaces (the middle unit) has been in need of constant repair. Site maintenance staff believe it is related to the fact that the main lobby and conference room are controlled by a shared thermostat, which creates comfort issues for the staff and puts large amounts of pressure on the system with constant thermostat changes.

Staff complaints include a lack of room-by-room temperature control. Heating vents in the building have fixed louvers to prevent back pressure in the system from closed louvers; however, to increase comfort, staff members regularly cover the vents completely, negating any benefits of the open louver vents, and potentially straining the furnace blower and causing burner problems.

The basement experiences minor flooding regularly due to groundwater seepage and there is no active ventilation system for the building (although its 1930s construction allows for considerable passive air movement). There is also concern over a presumed leak in the diesel fuel tank on the north side of the building, just outside the furnace room. The 1,000-gallon fuel oil tank shows visible signs of wear, and is due for replacement or removal.

The west wing has four identical Bryant Plus 90 propane-fired split furnace/A/C units rated at 128,000 BTU/hour (output) and are located in each of the four bathrooms in the wing (one per floor at each end of the wing). Each furnace serves its own heating zone. Four Bryant Model 563C-060 air conditioners (5.0 tons at SEER 12.0) provide cooling for each split system. A Reliance 30-gallon electric domestic water heater located in a janitor's closet provides hot water to each of the bathrooms across the building. All heat and cool air distribution is via forced air throughout the building.

Dispatch (#2301)

The Dispatch building has three sections: the main dispatch offices; a server room; and its training and auxiliary offices. The main dispatch offices are heated by two independently controlled electric wall units. An International Comfort Products Model CA5536VKD2 air conditioning unit (3 tons) at the south side of the building provides cooling to the main dispatch offices via forced air vents in the office floor.

The server room (which Wisewood was not given access to) has its own power and cooling sources. Two Lennox Model HS16-411v-4p (Est. rating 3.5 ton) air conditioners located at the back of the building provide cooling to the 85 square foot space.

The training area and additional offices are heated and cooled with thru-wall heat pump units that are independently controlled. The training area is generally only used 30-60 days per year and so is not a large heat load.

A 1,150-gallon propane tank sits centrally in the parking lot in front of the Dispatch building, to the east.

Maintenance Garage (#2101)

The Maintenance Garage is a long building with a large, open workshop area heated by two Dayton Model 3E383A ceiling-mounted propane-fired heating units (100 MBH rated output) and a smaller area (about one third of the building) containing offices and storage. The office space is heated by an unknown model Day and Night brand furnace. It has a domestic hot water heater with a capacity of _____. Cooling is provided by a Lennox air conditioner (model HS16-411v-4p, rated at 3.5 ton) located on the north side of the building.

Garage/Vehicle Wash (#2100)

The Garage and Vehicle Wash building is divided into two spaces. The south side contains the vehicle wash room with a single Modine (assumed 100 MBH) ceiling-mounted heater fired by propane. The adjacent heavy equipment storage area is not climate controlled.

The north end of the building houses a large storage space and offices. It is heated by a propane-fired furnace (unknown make and model) via forced air and cooled by a Lennox air conditioning unit (HS19-311V-4P, 2.5 ton) located on the south side of the building.

Workshop/Engineering (#2300)

The Workshop is divided into three open spaces: an old tire shop/storage on the southwest corner with no climate control; a large fire storage space on the east side with no climate control; and a central road crew shop/heavy equipment storage space on the northwest side of the building. This road crew shop is heated by one ceiling-mounted Dayton Fuel-Trimmer (100 MBH) propane-fired heating unit and one wood stove burning cordwood. There is no plumbing in the building and no cooling.

A 1,154-gallon propane tank sits behind the Workshop on its south side.

Storage (#2202)

Wisewood was not given access to the Storage building, but was informed by maintenance staff that it is heated by four ceiling-mounted heating units (assumed 100 MBH each) fired by propane (one in each of the four building sections). There is no cooling and no plumbing in the building.

A 460-gallon propane tank sits to the east of the Storage building along the edge of the overflow parking lot.

Warehouse (#2201)

The Warehouse's main storage area is heated by a single ceiling-mounted Dayton Fuel-Trimmer (100 MBH) propane-fired heating unit and does not have cooling. The small office space at the south end of the building is heated by another single Dayton propane-fired heating unit mounted on the ceiling. Cooling is provided by a single wall-mounted air conditioning unit.

A 499-gallon propane tank sits between the Warehouse and Engineering buildings, to the east side.

Engineering (#2200)

The Engineering building is heated by a Xenon 24.5" furnace fired by propane. It is cooled by a Goodman air conditioner (estimated at 2.5 tons). Domestic hot water is assumed to be provided by a small electric hot water heater in the rest rooms.

Natural Resources Office (#2001)

The Natural Resources Office is heated by a oil-fired furnace (unknown make and model) located in the basement. It is cooled by two air conditioning units, one Rheem and (Model 13AJA60A01757, rated at 5 tons) one International Comfort Products (estimated at 5 tons) . Domestic hot water is heated by a single 6-gallon hot water heater, also located in the basement. A 250-gallon fuel oil (diesel) tank sits behind the building on the east side.

Energy Use

From January to December of 2010, the Supervisor's Office in Quincy used 10,475 gallons of propane at a cost of $23,208 (an average price of $2.22/gallon). In 2011, this increased to 11,506 gallons of propane at a cost of $29,257 (an average price of $2.54/gallon).

In the fall (October-December) of 2011, the Supervisor's Office used 1,775 gallons of #2 fuel oil (diesel) at a cost of $6,471 (an average price of $3.65/gallon). In 2012, a total of 3,266 gallons of fuel oil were used at a cost of $12,407 (an average price of $3.80/gallon). In the winter and spring of 2013 (January-May), 2,010 gallons of fuel oil were used at a cost of $7,750 (an average price of $3.85/gallon).

Proposed Biomass Heating and Cooling Scenarios

Wisewood assessed two scenarios for provided heating and cooling from biomass to some or all of the buildings at the Plumas NF Supervisor's Office facility.

Scenario 1: Campus Wide Heating and Cooling

Scenario 1 aims to cover all heating and cooling loads at the Supervisor's Office with a combined biomass boiler and water-fired chiller. The model assumes that the heating energy replaced includes all propane and heating oil consumed on-site. Cooling energy to be replaced is currently assumed to be 30,000 kWh/yr, and requires further verification.

A centrally-located boiler/chiller would provide hot water and chilled water via underground pipes (4-pipe) to new air handlers in each of the conditioned spaces on the SO campus. A 4-pipe system (separate hot water and chilled water distribution piping) would allow for simultaneous heating and cooling of different buildings at the SO campus, which is something that occurs with the existing system, based on interviews with occupants. While this could cause inefficiencies if both heating and cooling energy are applied to different zones of the same building at the same time, different buildings have widely varying thermal comfort profiles, and the ability to provide heating and cooling simultaneously could be advantageous. A site map showing one proposed boiler location and pipe layouts is included at the end of the report narrative, before site photos.

Alternately, a 2-pipe system could supply both hot and chilled water to each of the conditioned spaces, with a twice per year seasonal changeover from heating to cooling. This would enable significant cost savings on distribution pipe installation and possible controls as well.

To meet the heat demand from all of the Supervisor's Office nine buildings, a biomass boiler rated at 750 MBH would cover 90% of heating needs. This means that a new propane-fired "peaking" and low-load boiler would meet 10% of annual heat demand, on average; most of this demand would be incurred on extremely cold ("peak") days and on "shoulder" seasons, when outside temperatures are still cool, but heat is only required for a few hours in the morning or evening. During these times, a propane or oil boiler can be a more efficient heat source, as they can fire up and down within minutes, whereas the biomass boiler system may require up to an hour to warm up.

To meet the estimated cooling demand from all nine buildings, a water-fired chiller rated at 240 MBH would cover 87% of cooling needs, with existing electric air conditioners or new compression chiller meeting the remaining 13% of cooling needs. In a 4-pipe system, concurrent cooling/heating is possible, allowing some zones to be chilled while others remained heated. In a 2-pipe system, the system would supply either heating or cooling exclusively. With this option, the cooling demand would only require the biomass boiler's low-fire setting to run.

Scenario 1 Energy Savings

Fossil energy savings: 1,339 MMBtu/yr
Biomass utilization: 116 tons/yr

The Quincy Supervisor's Office can expect to use approximately 116 tons of wood fuel per year (based on local heating degree day data) at a total cost of $11,576, assuming wood $100/green ton and 25% moisture content. The continued use of fossil fuel during peak loads and shoulder seasons will cost approximately $3,956. Total heating and cooling fuel costs will be reduced by approximately 81%.

Scenario 2: Main Buildings (2000, 2001, 2200, 2301), Heating Only

Scenario 2 aims to cover only the heating loads of buildings 2000, 2001, 2200, 2301 at the Supervisor's Office with a biomass boiler system. Heating energy replaced includes 80% of the propane and all heating oil consumed on-site.

A centrally-located boiler would provide hot water via underground pipes (2-pipe) to new air handlers in each of the conditioned spaces on the Supervisor's Office campus. The existing cooling systems would be retained. A site map showing one proposed boiler location and pipe layouts is included at the end of the report narrative.

To meet the heat demand from the Supervisor's Office main buildings (numbers 2000, 2001, 2200, and 2301), a biomass boiler rated at 500 MBH would cover 91% of heating needs. This means that a secondary fossil fuel boiler would meet 9% of heat demand, on average; most of this demand is represented on extremely cold ("peak") days and on "shoulder" seasons.

Scenario 2 Energy Savings

Fossil energy savings: 1,186 MMBtu/yr
Biomass utilization: 102 tons/yr

The Quincy Supervisor's Office can expect to use approximately 102 tons of wood fuel per year in this scenario (based on local heating degree day data) at a total cost of $10,188. The continued use of the existing propane and oil boilers during peak loads and shoulder seasons will cost approximately $2,896. Total heating and cooling fuel costs will be reduced by approximately 81%.

Technology Assessed

The technology assessed includes a biomass boiler capable of utilizing small, dry wood chips (2" minus, 35% moisture content or less) with a thermal energy storage tank, and in the case of the water-fired chiller, a lithium-bromide single-effect water fired chiller is assumed.

The assessment assumes state-of-the-art biomass boiler systems that incorporate full automation of all major functions, including automatic ignition, unattended modulating operation, and automatic de-ashing. Additionally, the system would have the components required for consistently low emissions levels with variable quality fuels: an oxygen sensor and flue gas temperature sensor-based combustion control system; distinct primary and secondary combustion zones; and flue gas recirculation.

The system performance and cost estimates are based on modern, high efficiency boilers with a proven track record, requiring only minimal work to maintain or adjust when fuel conditions change. The system cost estimates also assume that a new prefabricated boiler house and fuel storage system would be built as a stand-alone structure, with associated slab construction and trenching costs.

Site Considerations

A new 10-year Master Plan that is currently being evaluated may include recommendations that a new building be constructed on the site to replace most of the existing infrastructure and consolidate offices. The Main Office could be required to remain, as it is vintage 1930s and may come under protection of the California State Historic Preservation Office (SHPO) rules.

There are several viable options on the Supervisor's Office site for placing a biomass boiler. One ideal location is the seven-car garage in the center of the main parking lot. Another ideal location is the northeast corner of the property in the overflow parking lot, making potential interconnection to Quincy High School feasible via the an adjacent pedestrian pathway.

According to maintenance staff, there is a large oil spill around the 1,150-gallon propane tank in the central parking lot near the Dispatch building. The spill was monitored for 15 years and found not to migrate, so it has not been mitigated. Should construction require that site soils be removed, it may require permitting, testing, or other measures.

Financial analysis

For both scenarios considered, the following data were used: an escalation rate for fossil fuels (oil and propane) of 5.8% (based on US DOE EIA commerical propane price data); an escalation rate for wood fuels of 2.0%; and an escalation rate of 2.0% for electricity. The total installation costs include, but are not limited to: project development and management; design and engineering; permitting; equipment; labor; interconnection with existing systems; site work; concrete; building installation; commissioning; 10% unlisted items allowance; and 11% contingency allowance.

The total cost of installation of Scenario 1 is estimated to be $1.36 million. The payback on this system based on fuel savings is approximately 25 years. Annual operating costs will be reduced by over 52% in the first year, growing to an estimated 75% operating savings by year 30 as fossil fuel prices continue to rise at a faster rate than woody biomass fuels.

The total cost of installation of Scenario 2 is estimated to be $900,000. The payback on this system based on fuel savings is approximately 20 years. Annual operating costs will be reduced by over 55% in the first year, growing to an estimated 79% operating savings by year 30.

These costs may be partially offset by additional incentives through state and federal tax credits, grants, or low- and no-interest loans.

Recommendations

Before a final biomass boiler design is considered, the USFS should decide what energy efficiency measures it may take in the near future (window replacement, insulation, lighting retrofits, etc.) so that the boiler can be sized to match the resultant decrease in energy demand. This is especially true for any potential Master Plan that may include new construction, which would drastically alter the energy use profiles and recommended boiler placements.

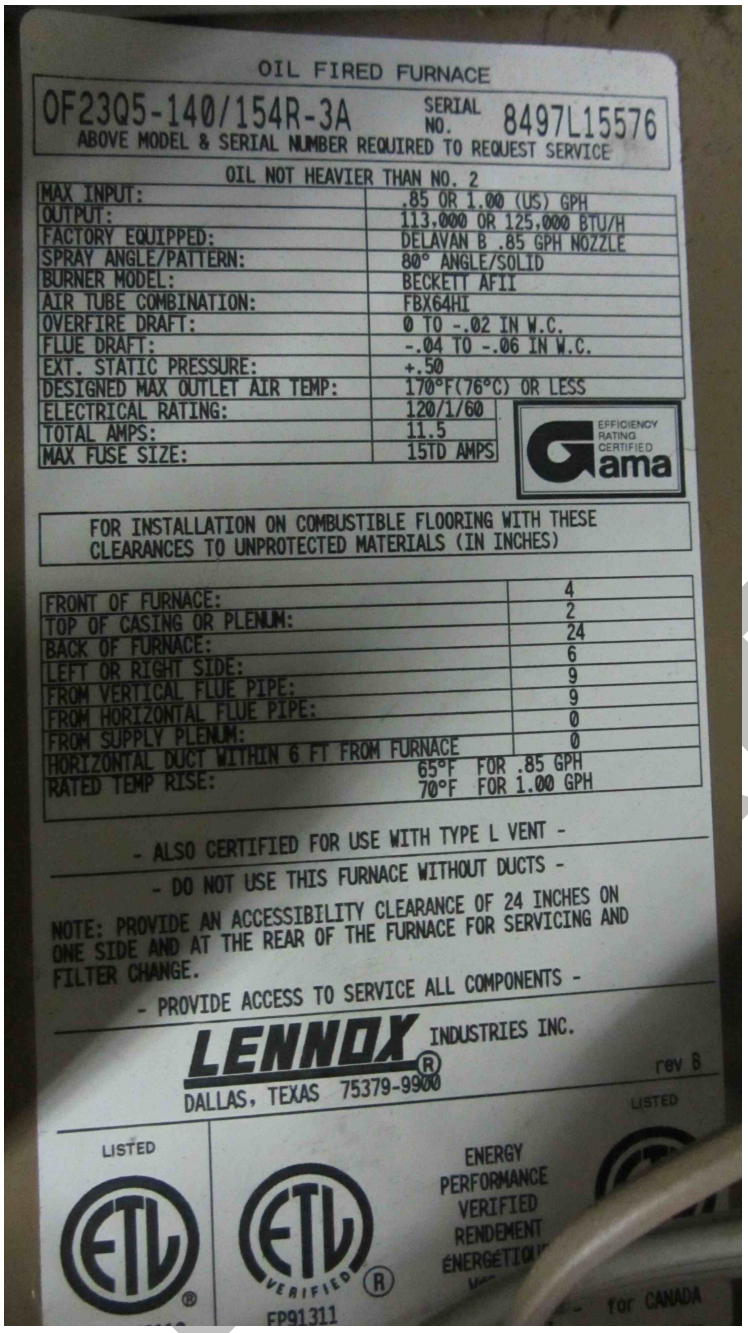
Scenario 1 Proposed Boiler Location and Pipe Layout (heating and cooling for all campus buildings)

Scenario 2 Proposed Boiler Location and Pipe Layout (heating only for four buildings)

Site Photos

Main Office (#2000)

East wing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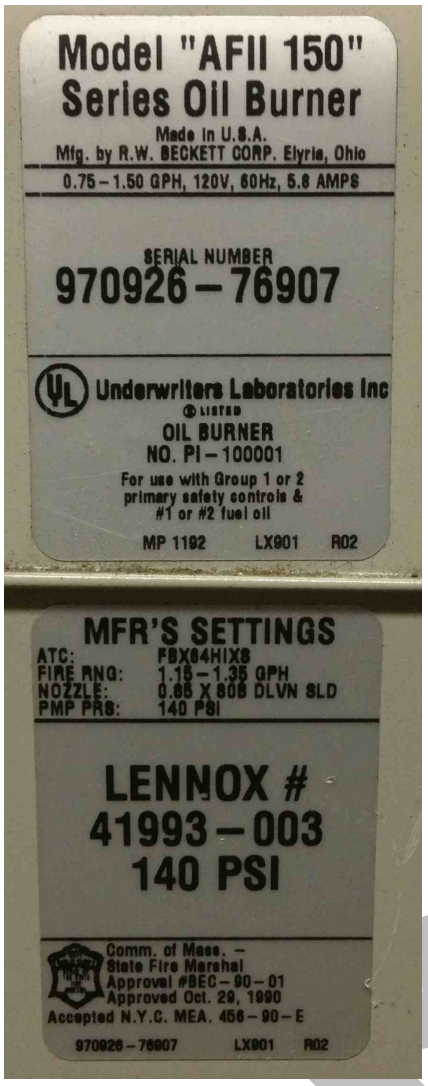
ABOVE MODEL & SERIAL NUMBER REQUIRED TO REQUEST SERVICE
OIL NOT HEAVIER THAN NO. 2
MAX INPUT: .85 OR 1.00 (US) GPH
OUTPUT: 113,000 OR 125,000 BTU/H
FACTORY EQUIPPED: DELAVAN B .85 GPH NOZZLE
SPRAY ANGLE/PATTERN: 80° ANGLE/SOLID
BURNER MODEL: BECKETT AFII
AIR TUBE COMBINATION: FBX64HI
OVERFIRE DRAFT: 0 TO -.02 IN W.C.
FLUE DRAFT: -.04 TO -.06 IN W.C.
EXT. STATIC PRESSURE: +.50
DESIGNED MAX OUTLET AIR TEMP: 170°F(76°C) OR LESS
ELECTRICAL RATING: 120/1/60
TOTAL AMPS: 11.5
MAX FUSE SIZE: 15TD AMPS
EFFICIENCY RATING CERTIFIED
Gama
FOR INSTALLATION ON COMBUSTIBLE FLOORING WITH THESE CLEARANCES TO UNPROTECTED MATERIALS (IN INCHES)
FRONT OF FURNACE: 4
TOP OF CASING OR PLENUM: 2
BACK OF FURNACE: 24
LEFT OR RIGHT SIDE: 6
FROM VERTICAL FLUE PIPE: 9
FROM HORIZONTAL FLUE PIPE: 9
FROM SUPPLY PLENUM: 0
HORIZONTAL DUCT WITHIN 6 FT FROM FURNACE 0
RATED TEMP RISE: 65°F FOR .85 GPH
70°F FOR 1.00 GPH
- ALSO CERTIFIED FOR USE WITH TYPE L VENT -
- DO NOT USE THIS FURNACE WITHOUT DUCTS -
NOTE: PROVIDE AN ACCESSIBILITY CLEARANCE OF 24 INCHES ON ONE SIDE AND AT THE REAR OF THE FURNACE FOR SERVICING AND FILTER CHANGE.
- PROVIDE ACCESS TO SERVICE ALL COMPONENTS -
LENNOX INDUSTRIES INC.
DALLAS, TEXAS 75379-9900
rev B
LISTED
ETL
ETL VERIFIED
FP91311
ENERGY PERFORMANCE VERIFIED
RENDEMENT ÉNERGÉTIQUE
for CANADA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Made in U.S.A.
Mfg. by R.W. BECKETT CORP. Elyria, Ohio
0.75 – 1.50 GPH, 120V, 60Hz, 5.8 AMPS
SERIAL NUMBER
970926 – 76907
Underwriters Laboratories Inc
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NO. PI – 100001
For use with Group 1 or 2
primary safety controls &
#1 or #2 fuel oil
MP 1192 LX901 R02
MFR'S SETTINGS
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FIRE RNG: 1.15 – 1.35 GPH
NOZZLE: 0.85 X 80B DLVN SLD
PMP PRS: 140 PSI
LENNOX #
41993 – 003
140 PSI
Comm. of Mass. –
State Fire Marshal
Approval #BEC – 90 – 01
Approved Oct. 29, 1990
Accepted N.Y.C. MEA. 456 – 90 – E
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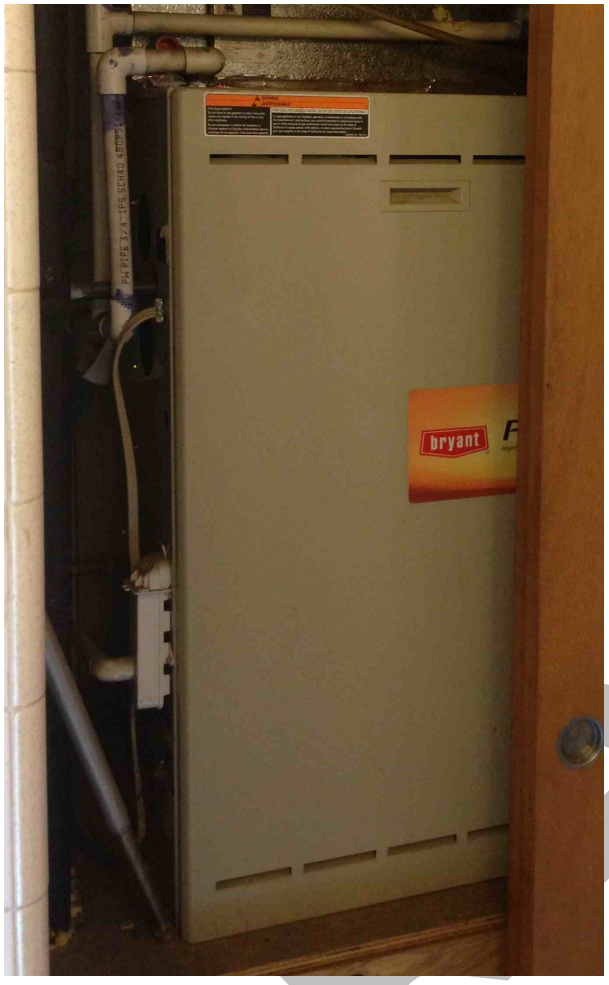
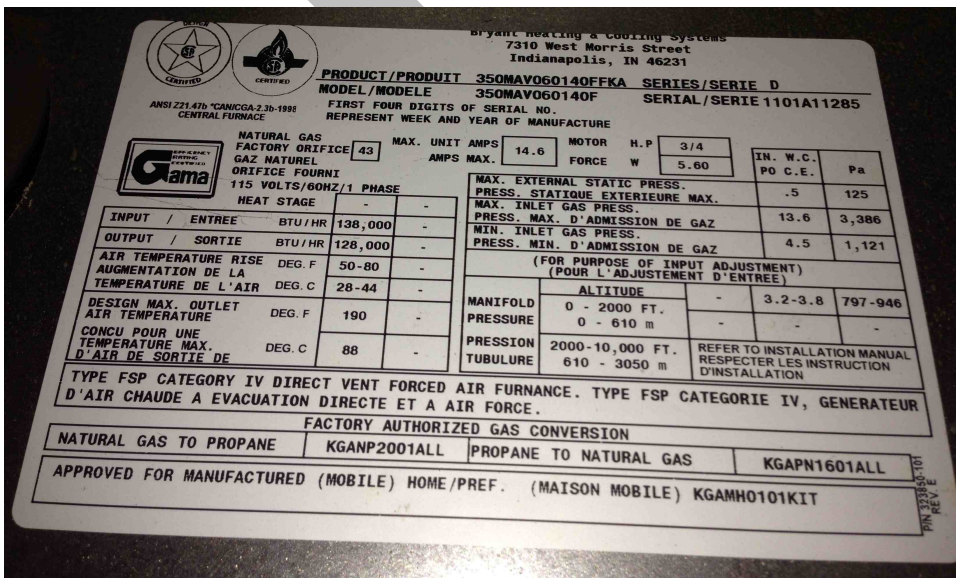
West wing




Bryant Heating & Cooling Systems
7310 West Morris Street
Indianapolis, IN 46231

PRODUCT/PRODUIT 350MAV060140FFKA SERIES/SERIE D
MODEL/MODELE 350MAV060140F SERIAL/SERIE 1101A11285

ANSI Z21.47b *CAN/CGA-2.3b-1998 CENTRAL FURNACE

FIRST FOUR DIGITS OF SERIAL NO. REPRESENT WEEK AND YEAR OF MANUFACTURE

NATURAL GAS FACTORY ORIFICE 43
GAZ NATUREL ORIFICE FOURNI
115 VOLTS/60HZ/1 PHASE

MAX. UNIT AMPS 14.6
AMPS MAX.

MOTOR H.P 3/4
FORCE W 5.60

		IN. W.C.	Pa
MAX. EXTERNAL STATIC PRESS. PRESS. STATIQUE EXTERIEURE MAX.		.5	125
MAX. INLET GAS PRESS. PRESS. MAX. D'ADMISSION DE GAZ		13.6	3,386
MIN. INLET GAS PRESS. PRESS. MIN. D'ADMISSION DE GAZ		4.5	1,121
HEAT STAGE		-	-
INPUT / ENTREE	BTU/HR	138,000	-
OUTPUT / SORTIE	BTU/HR	128,000	-
AIR TEMPERATURE RISE AUGMENTATION DE LA TEMPERATURE DE L'AIR	DEG. F	50-80	-
	DEG. C	28-44	-
DESIGN MAX. OUTLET AIR TEMPERATURE	DEG. F	190	-
CONCU POUR UNE TEMPERATURE MAX. D'AIR DE SORTIE DE	DEG. C	88	-

(FOR PURPOSE OF INPUT ADJUSTMENT)
(POUR L'ADJUSTEMENT D'ENTREE)

	ALTITUDE			
MANIFOLD PRESSURE	0 - 2000 FT.	-	3.2-3.8	797-946
	0 - 610 m	-	-	-
PRESSION TUBULURE	2000-10,000 FT. 610 - 3050 m	REFER TO INSTALLATION MANUAL RESPECTER LES INSTRUCTION D'INSTALLATION		

TYPE FSP CATEGORY IV DIRECT VENT FORCED AIR FURNANCE. TYPE FSP CATEGORIE IV, GENERATEUR D'AIR CHAUDE A EVACUATION DIRECTE ET A AIR FORCE.

FACTORY AUTHORIZED GAS CONVERSION

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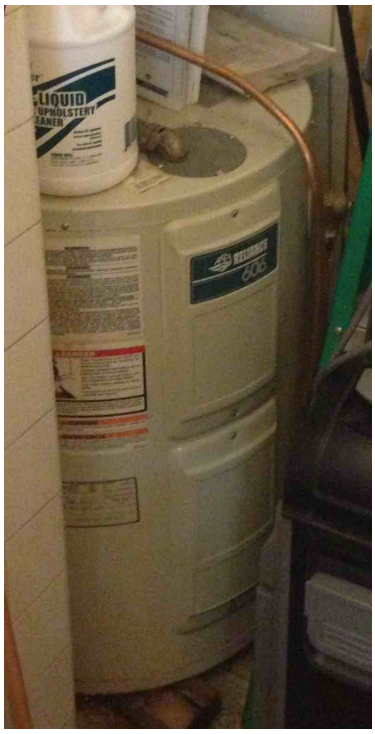
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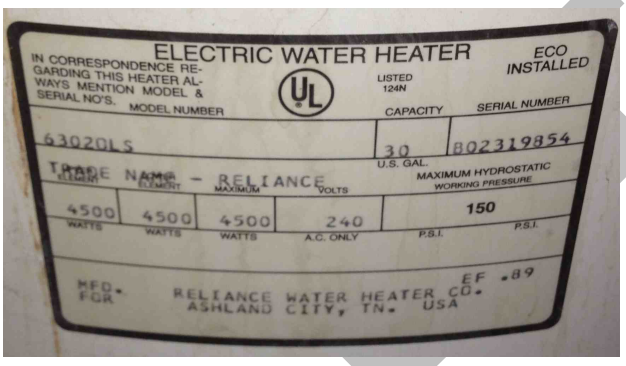
UPHOLSTERY
RELIANCE
6006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ECO INSTALLED
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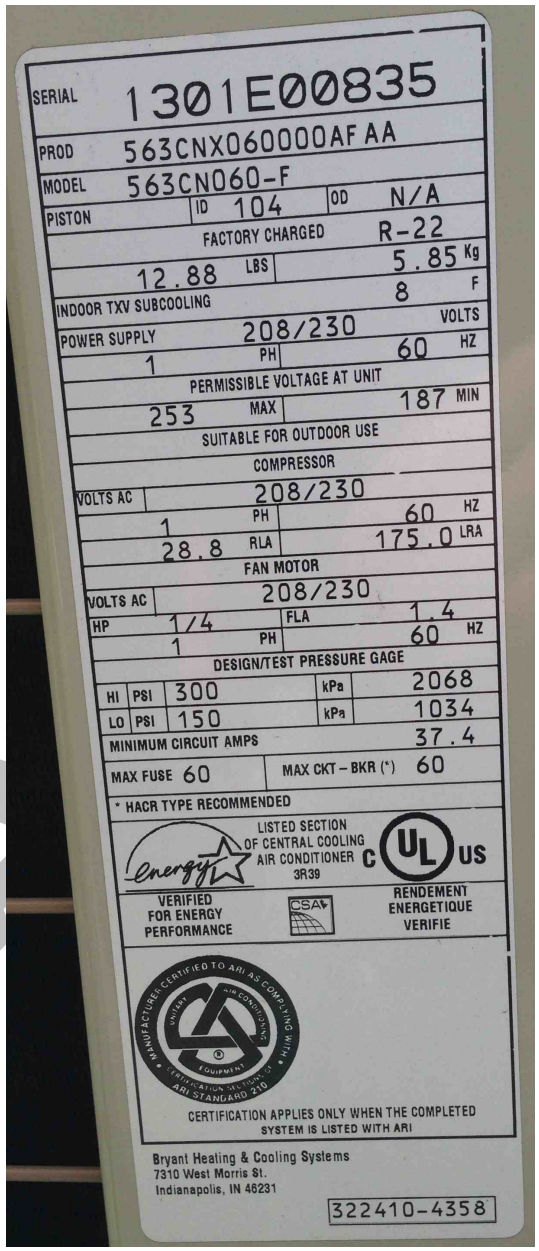
CAPACITY
SERIAL NUMBER
6302OLS
30
U.S. GAL.
802319854
TRADE NAME - RELIANCE
MAXIMUM HYDROSTATIC WORKING PRESSURE
ELEMENT
MAXIMUM
VOLTS
4500 WATTS
4500 WATTS
4500 WATTS
240 A.C. ONLY
150 P.S.I.
P.S.I.
EF .89
MFD. FOR
RELIANCE WATER HEATER CO.
ASHLAND CITY, TN. USA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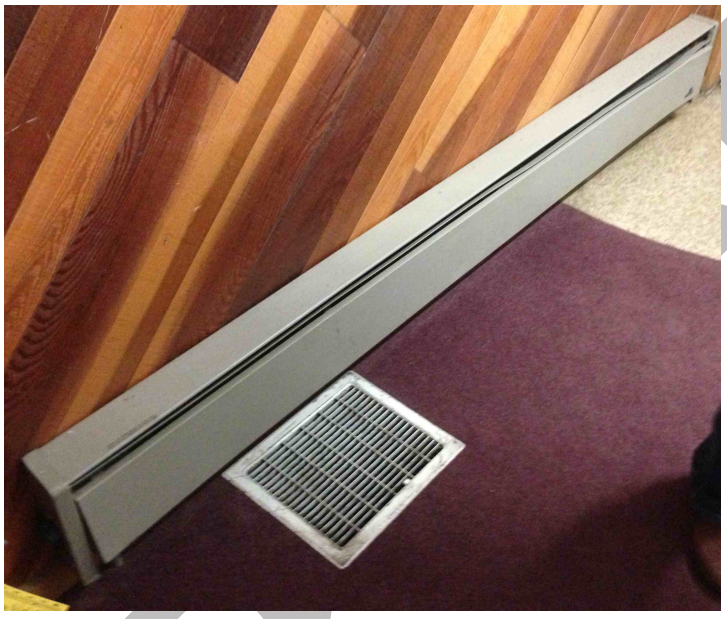
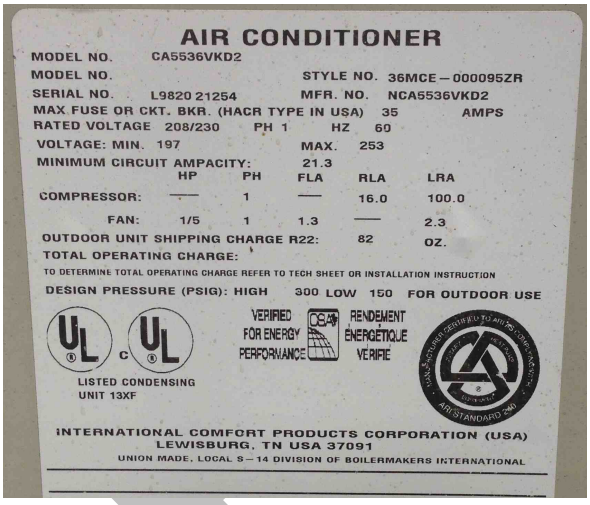
INDOOR TXV SUBCOOLING 8 F
POWER SUPPLY 208/230 VOLTS
1 PH 60 HZ
PERMISSIBLE VOLTAGE AT UNIT
253 MAX 187 MIN
SUITABLE FOR OUTDOOR USE
COMPRESSOR
VOLTS AC 208/230
1 PH 60 HZ
28.8 RLA 175.0 LRA
FAN MOTOR
VOLTS AC 208/230
HP 1/4 FLA 1.4
1 PH 60 HZ
DESIGN/TEST PRESSURE GAGE
HI PSI 300 kPa 2068
LO PSI 150 kPa 1034
MINIMUM CIRCUIT AMPS 37.4
MAX FUSE 60 MAX CKT – BKR (*) 60
* HACR TYPE RECOMMENDED
LISTED SECTION OF CENTRAL COOLING AIR CONDITIONER 3R39
VERIFIED FOR ENERGY PERFORMANCE
RENDEMENT ENERGETIQUE VERIFIE
CERTIFICATION APPLIES ONLY WHEN THE COMPLETED SYSTEM IS LISTED WITH ARI
Bryant Heating & Cooling Systems
7310 West Morris St.
Indianapolis, IN 46231
322410-4358

Dispatch (#2301)




TEMPSTAR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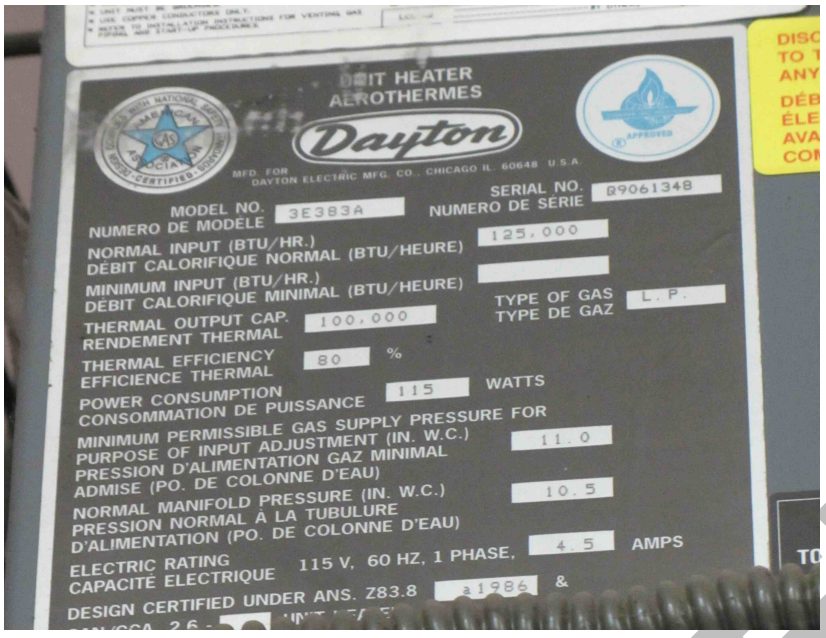
MAX FUSE OR CKT. BKR. (HACR TYPE IN USA) 35 AMPS
RATED VOLTAGE 208/230 PH 1 HZ 60
VOLTAGE: MIN. 197 MAX. 253
MINIMUM CIRCUIT AMPACITY: 21.3
HP PH FLA RLA LRA
COMPRESSOR: — 1 — 16.0 100.0
FAN: 1/5 1 1.3 — 2.3
OUTDOOR UNIT SHIPPING CHARGE R22: 82 OZ.
TOTAL OPERATING CHARGE:
TO DETERMINE TOTAL OPERATING CHARGE REFER TO TECH SHEET OR INSTALLATION INSTRUCTION
DESIGN PRESSURE (PSIG): HIGH 300 LOW 150 FOR OUTDOOR USE
LISTED CONDENSING UNIT 13XF
VERIFIED FOR ENERGY PERFORMANCE
RENDEMENT ÉNERGÉTIQUE VÉRIFIÉ
INTERNATIONAL COMFORT PRODUCTS CORPORATION (USA)
LEWISBURG, TN USA 37091
UNION MADE, LOCAL S—14 DIVISION OF BOILERMAKERS INTERNATIONAL


WARMER
COOLER
TEMP
STOP
LOW FAN
HIGH FAN
LOW HEAT
HIGH HEAT
LOW COOL
HIGH COOL
MODE

Maintenance Garage (#2101)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AEROTHERMES
Dayton
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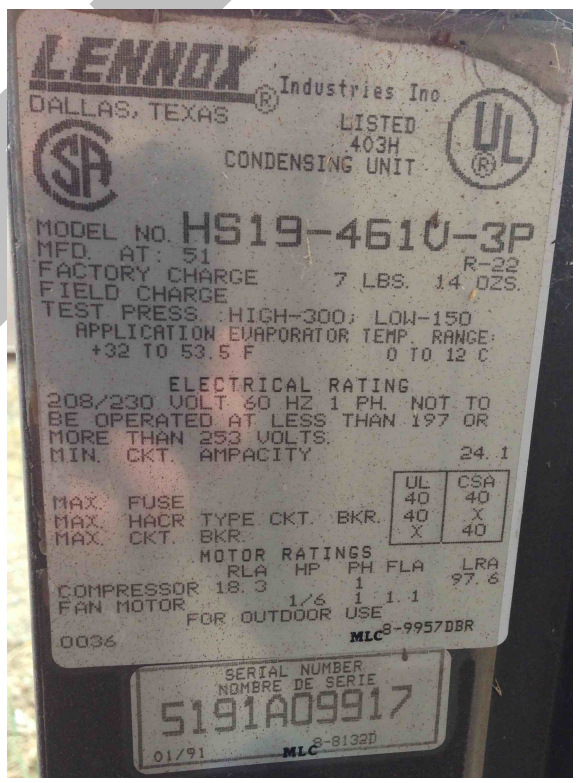
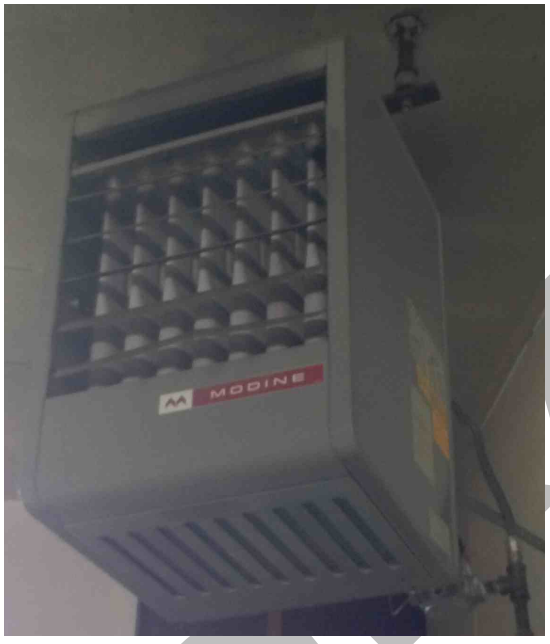
MINIMUM INPUT (BTU/HR.) DÉBIT CALORIFIQUE MINIMAL (BTU/HEURE)
THERMAL OUTPUT CAP. RENDEMENT THERMAL 100,000
TYPE OF GAS TYPE DE GAZ L.P.
THERMAL EFFICIENCY EFFICIENCE THERMAL 80 %
POWER CONSUMPTION CONSOMMATION DE PUISSANCE 115 WATTS
MINIMUM PERMISSIBLE GAS SUPPLY PRESSURE FOR PURPOSE OF INPUT ADJUSTMENT (IN. W.C.) PRESSION D'ALIMENTATION GAZ MINIMAL ADMISE (PO. DE COLONNE D'EAU) 11.0
NORMAL MANIFOLD PRESSURE (IN. W.C.) PRESSION NORMAL À LA TUBULURE D'ALIMENTATION (PO. DE COLONNE D'EAU) 10.5
ELECTRIC RATING CAPACITÉ ELECTRIQUE 115 V, 60 HZ, 1 PHASE, 4.5 AMPS
DESIGN CERTIFIED UNDER ANS. Z83.8 a1986 &


LENNOX
LENNOX Industries Inc.
DALLAS, TEXAS
REFRIGERANT EVAPORATOR
MODEL NUMBER
CH16-41-1FF
MFD. AT: 54
REFRIGERANT: REFRIGERANT-22
DESIGN PRESSURE: 300 PSIG
0315
MLC 8-9932DC
SERIAL NUMBER
5491A02123
01/91
MLC 8-7306D


LENNOX Industries Inc.
DALLAS, TEXAS
LISTED
403H
CONDENSING UNIT
MODEL NO. HS19-461C-3P
MFD. AT: 51
FACTORY CHARGE R-22
FIELD CHARGE 7 LBS. 14 OZS.
TEST PRESS. HIGH-300; LOW-150
APPLICATION EVAPORATOR TEMP. RANGE:
+32 TO 53.5 F 0 TO 12 C
ELECTRICAL RATING
208/230 VOLT 60 HZ 1 PH. NOT TO
BE OPERATED AT LESS THAN 197 OR
MORE THAN 253 VOLTS.
MIN. CKT. AMPACITY 24.1
MAX. FUSE
MAX. HACR TYPE CKT. BKR.
MAX. CKT. BKR.
UL CSA
40 40
40 X
X 40
MOTOR RATINGS
RLA HP PH FLA LRA
COMPRESSOR 18.3 1 97.6
FAN MOTOR 1/6 1 1.1
FOR OUTDOOR USE
0036
MLC 8-9957DBR
SERIAL NUMBER
NOMBRE DE SERIE
5191A09917
01/91
MLC 8-8132D

Garage/Vehicle Wash (#2100)

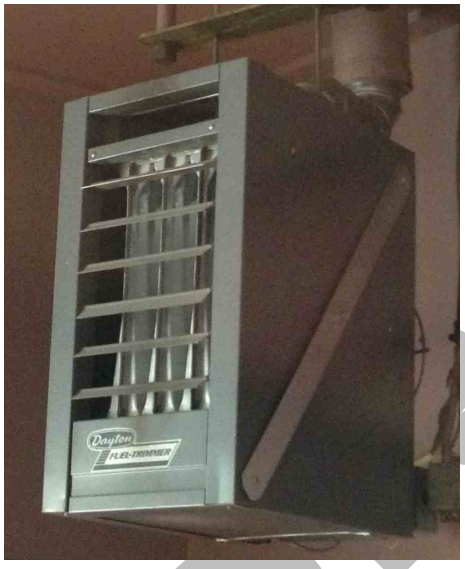



LENNOX Industries Inc.
DALLAS, TEXAS
LISTED
403H
CONDENSING UNIT
MODEL NO. HS19-311V-4P
R-22
MFD AT: 51
FACTORY CHARGE 6 LBS. 9 OZS.
FIELD CHARGE
DESIGN PRESSURE: HIGH-300 ; LOW-150
APPLICATION EVAPORATOR TEMP. RANGE:
+32 TO 53.5 F 0 TO 12 C
ELECTRICAL RATING
208/230 VOLT 60 HZ 1 PH. NOT TO BE OPERATED AT LESS THAN 197 OR MORE THAN 253 VOLTS.
MIN. CKT. AMPACITY 18.9
MAX. FUSE OR HACR TYPE CKT. BKR. 30 AMP
MOTOR RATINGS
RLA HP PH FLA LRA
COMPRESSOR 14.2 1 66
FAN MOTOR 1/6 1 1.1
FOR OUTDOOR USE
0402
MLC
8-9957DT

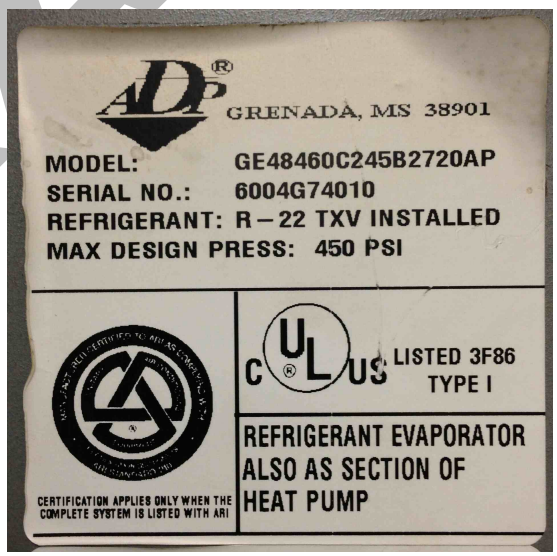
Workshop/Engineering (#2300)

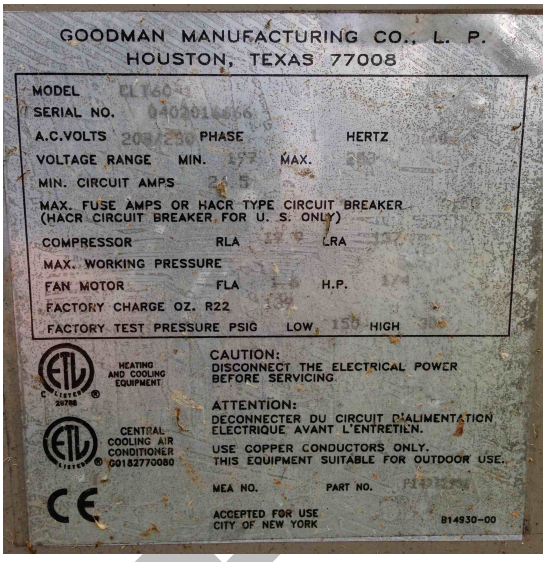
Storage (#2202)

Warehouse (#2201)



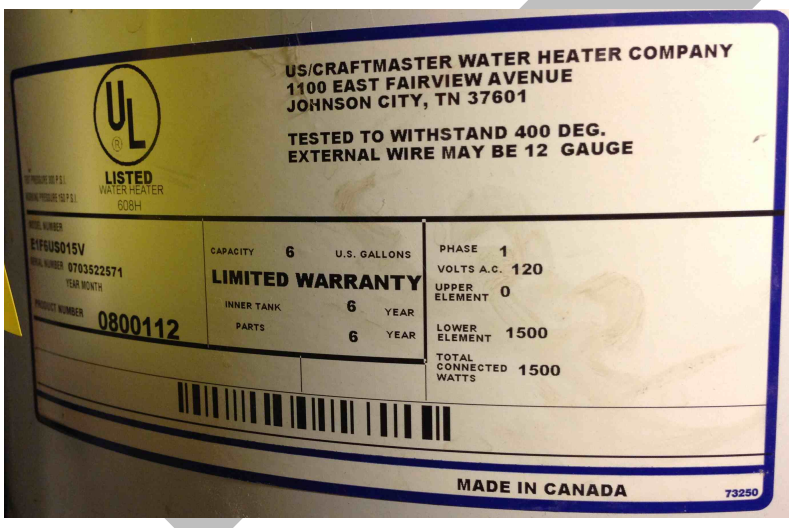
Engineering (#2200)

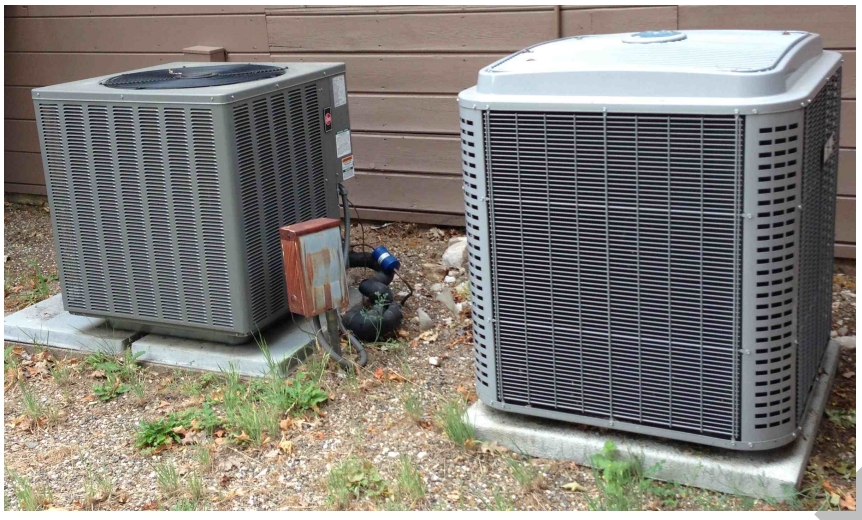


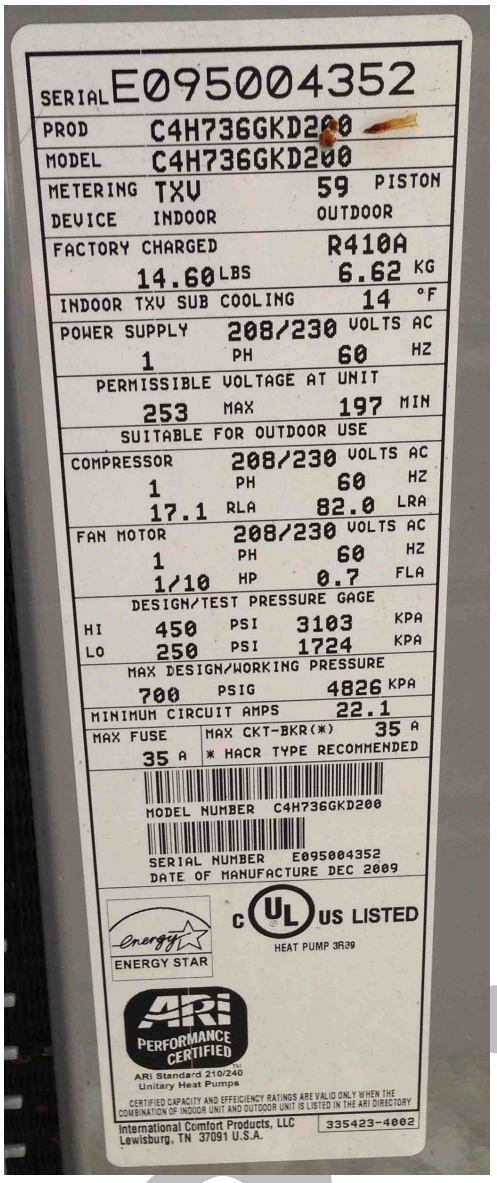

GOODMAN MANUFACTURING CO., L. P.
HOUSTON, TEXAS 77008
MODEL
SERIAL NO.
A.C.VOLTS
PHASE
HERTZ
VOLTAGE RANGE MIN.
MAX.
MIN. CIRCUIT AMPS
MAX. FUSE AMPS OR HACR TYPE CIRCUIT BREAKER (HACR CIRCUIT BREAKER FOR U. S. ONLY)
COMPRESSOR
RLA
LRA
MAX. WORKING PRESSURE
FAN MOTOR
FLA
H.P.
FACTORY CHARGE OZ. R22
FACTORY TEST PRESSURE PSIG
LOW
HIGH
HEATING AND COOLING EQUIPMENT
CENTRAL COOLING AIR CONDITIONER
CAUTION:
DISCONNECT THE ELECTRICAL POWER BEFORE SERVICING.
ATTENTION:
DECONNECTER DU CIRCUIT D'ALIMENTATION ELECTRIQUE AVANT L'ENTRETIEN.
USE COPPER CONDUCTORS ONLY.
THIS EQUIPMENT SUITABLE FOR OUTDOOR USE.
MEA NO.
PART NO.
ACCEPTED FOR USE CITY OF NEW YORK
B14930-00

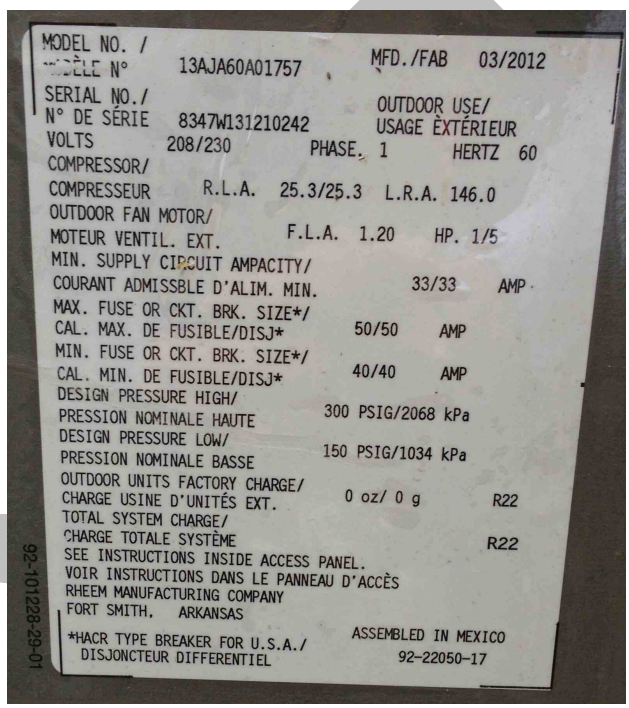
Natural Resources Office (#2001)


WARNING
Explosion Hazard
If the temperature and pressure relief valve is dripping or leaking, have a qualified person replace it.
Examples of a qualified person include: licensed plumbers, authorized gas company personnel, and authorized service personnel.
Do not plug valve.
Do not remove valve.
Failure to follow these instructions can result in death or explosion.
US/CRAFTMASTER WATER HEATER COMPANY
1100 EAST FAIRVIEW AVENUE
JOHNSON CITY, TN 37601
TESTED TO WITHSTAND 400 DEG.
EXTERNAL WIRE MAY BE 12 GAUGE
LIMITED WARRANTY
100112
MADE IN CANADA


US/CRAFTMASTER WATER HEATER COMPANY
1100 EAST FAIRVIEW AVENUE
JOHNSON CITY, TN 37601
TESTED TO WITHSTAND 400 DEG.
EXTERNAL WIRE MAY BE 12 GAUGE
LISTED
WATER HEATER
608H
E1FSUS015V
0703522571
YEAR MONTH
0800112
CAPACITY 6 U.S. GALLONS
LIMITED WARRANTY
INNER TANK 6 YEAR
PARTS 6 YEAR
PHASE 1
VOLTS A.C. 120
UPPER ELEMENT 0
LOWER ELEMENT 1500
TOTAL CONNECTED WATTS 1500
MADE IN CANADA
73250







All photos: Wisewood, Inc.

Supervisor's Office

Scenario 1: Campus-Wide Heating and Cooling

USFS Supervisor's Office - Quincy

Wood-Fired Heating and Cooling

Energy Calculations

Bldgs: 2000, 2001, 2100, 2101, 2200, 2201, 2300, 2301

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Wood-Fired Heating and Cooling
System Output (MBH) 750
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us
Address 1001 SE Water Ave, Suite 255
Portland, OR 97214

Exisiting fossil fuel consumption (MMBtu/HDD)	0.243	Max. electrical demand (kW)	0.5	Current heating oil use, [gal/yr]	3,500
Existing Furnace Eff.	90%	Average electrical demand (kW)	0.3	Current propane use, [gal/yr]	10,991
Calculated exisiting heat input (MMBtu/HDD)	0.219	Annual use (kWhr)	807	Current heating oil cost, [$/yr]	$13,125
Efficiency gains (via EEMs)	0%	Estimated reduction in heating oil use	90%	Current propane cost, [$/yr]	$26,159
Wood Boiler Eff.	85.0%	Boiler output, high-fire (MBH)	750	Projected wood fuel use, [tons/yr]	116
Heating oil cost, $/gal.	$3.75	Boiler output, low-fire (MBH)	150	Projected propane use, [gal/yr]	1,662
Propane cost, $/gal.	$2.38	Average boiler output (MBH)	422	Projected wood fuel use, [$/yr]	$11,576
Electricity cost, $/kWhr	0.17	Wood MC, wet weight basis	25%	Projected heating oil use, [$/yr]	$3,956
Wood fuel cost, $/green ton	$100.00	Energy of Wood, mmBtu/ton, LHV	12.3	Projected electricity cost, [$/yr]	$65
Fossil fuel cost, $/mmBtu	$26.42	Energy of heating oil, Btu/gal, HHV	139000	Operating hours per day	12
Wood fuel cost, $/mmBtu	$8.13	Energy of propane, Btu/gal, HHV	92000	Operating hours, yr	2868

Month	Applicable Heating Degree Days [HDD]	Current gross fossil energy consumption, [MMBtu]	Current net space heat energy input [MMBtu]	Projected net space heat input after EEMs [mmBtu/mo]	Projected gross wood energy consumption, [MMBtu]	Projected gross fossil energy consumption, [MMBtu]
September	163	40	36	36	38	12
October	479	116	105	105	111	20
November	793	193	173	173	183	23
December	942	229	206	206	218	23
January	921	224	201	201	213	19
February	762	185	167	167	176	18
March	737	179	161	161	170	13
April	541	131	118	118	125	8
May	328	80	72	72	76	6
June	231	56	51	51	53	3
July	140	34	31	31	32	3
August	126	31	28	28	29	0
Yearly Total, or Avg.	6162	1,498	1,348	1,348	1,424	149

Net fossil energy savings, [MMBtu/yr] **1,349**

PRELIMINARY

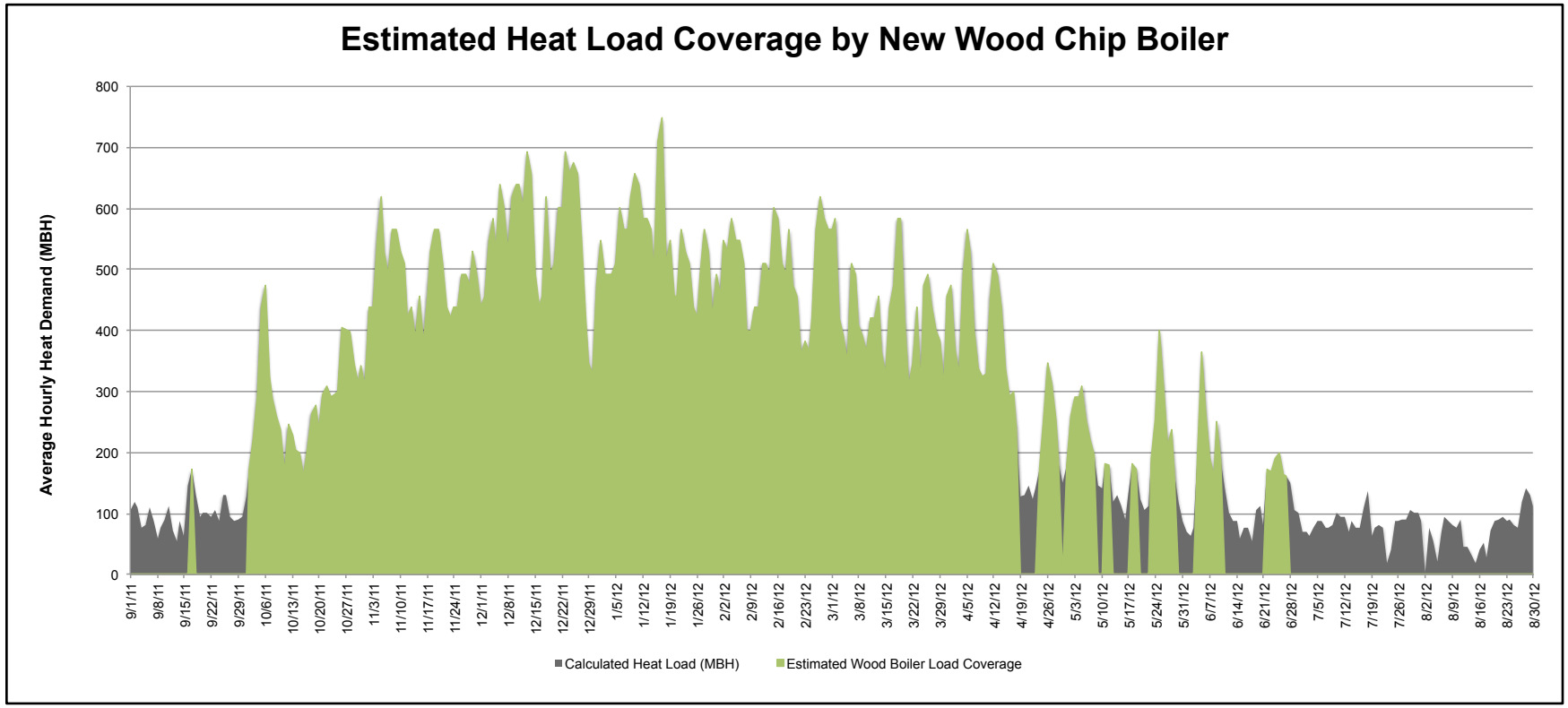
DRAFT - FOR COMMMENT

USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy

Energy Calculations

Project	USFS Supervisor's Office - Quincy	**System Description**	Wood-Fired Heating and Cooling	**Contact**	Andrew Haden
Location	Plumas, OR	**System Output (MBH)**	750	**Phone**	(503) 706-6187
Contact	Earl Ford	**Fuel Type**	Conditioned Forest Biomass (<2" ·	**Email**	andrew@wisewood.us
Date	7/9/13	**Workbook Version**	3.7.1		



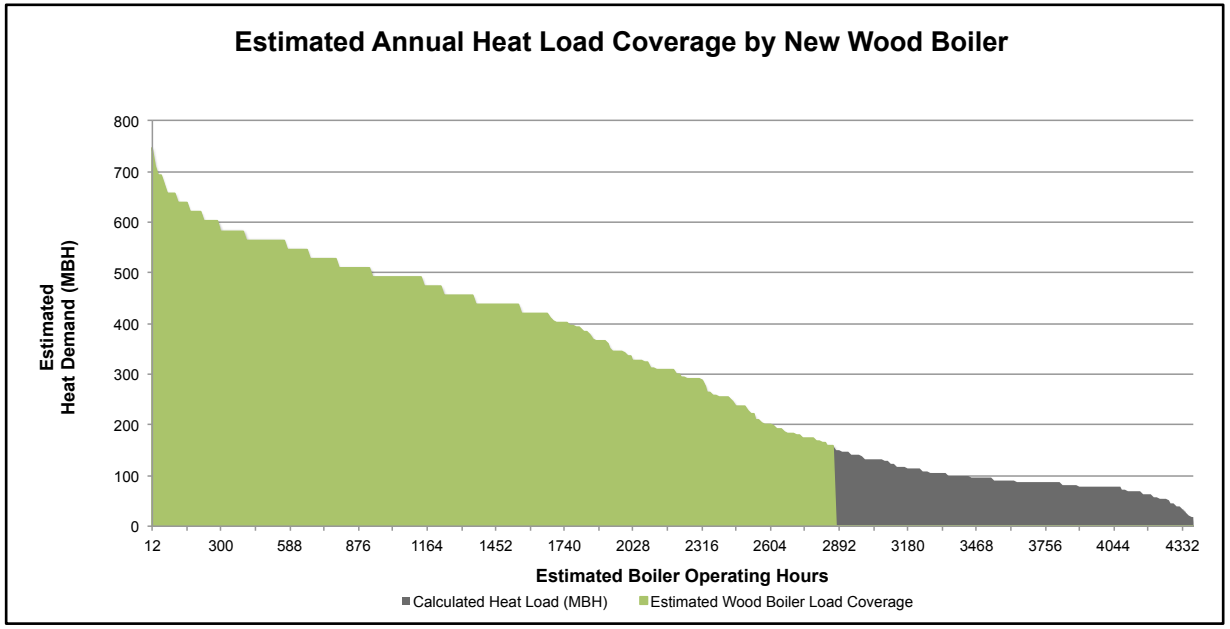
USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy
Energy Calculations

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

Boiler Option Wood-Fired Heating and Cooling
System Output (MBH) 750
Fuel Type Conditioned Forest Biomass (<2" ·
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us



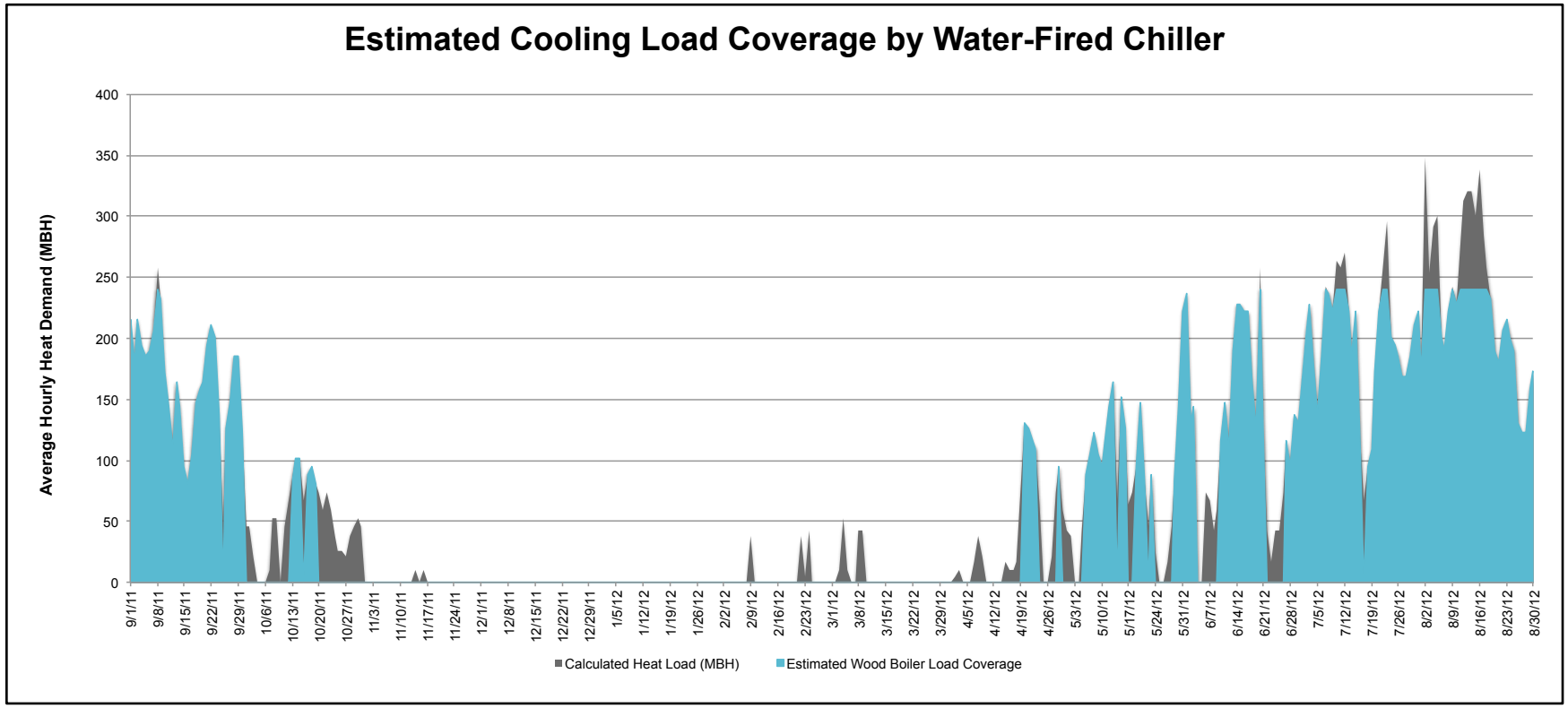
Boiler Output [MBH]	Fossil Fuel Displaced
34	11%
89	28%
136	39%
177	48%
205	53%
266	64%
341	76%
512	90%
750	90%
1024	86%
1365	82%
1842	70%
2457	47%
3241	5%
4265	0%
5459	0%
7165	0%
10236	0%
13648	0%
17060	0%
20472	0%
23884	0%
27296	0%
30708	0%
34120	0%

USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy

Energy Calculations -COOLING

Project	USFS Supervisor's Office - Quincy	**System Description**	Wood-Fired Heating and Cooling	**Contact**	Andrew Haden
Location	Plumas, OR	**System Output (MBH)**	240	**Phone**	(503) 706-6187
Contact	Earl Ford	**Fuel Type**	Conditioned Forest Biomass (<2" ·	**Email**	andrew@wisewood.us
Date	7/9/13	**Workbook Version**	3.7.1		



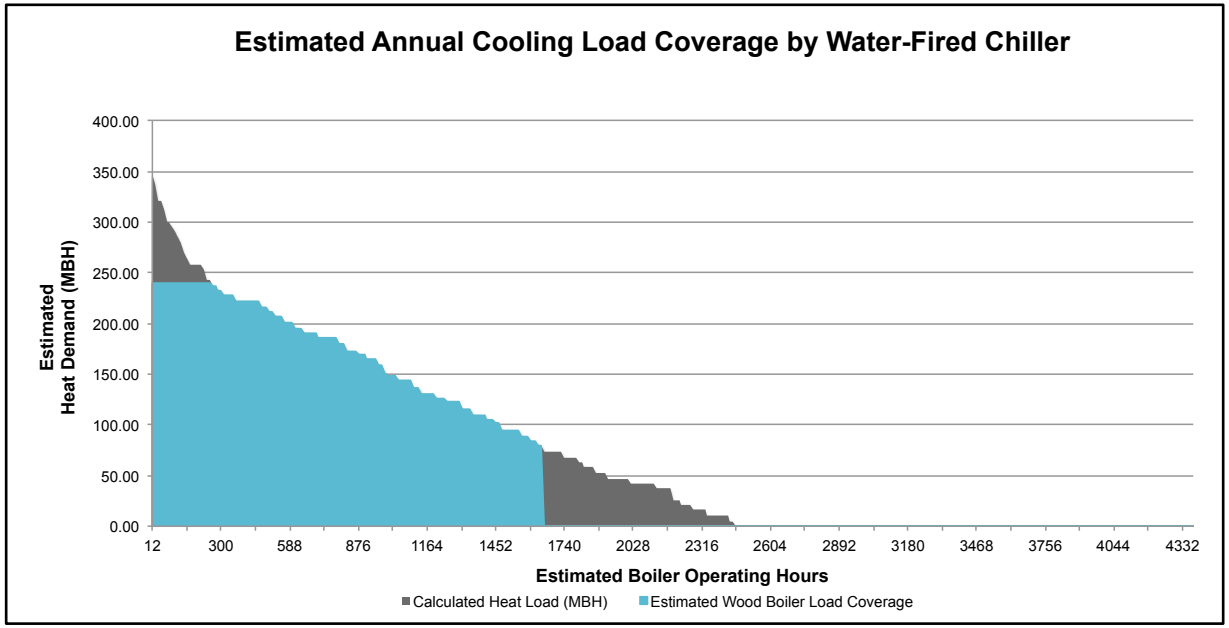
USFS Supervisor's Office - Quincy

USFS Supervisor's Office - Quincy
Energy Calculations -COOLING

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Wood-Fired Heating and Cooling
System Output (MBH) 240
Fuel Type Conditioned Forest Biomass (<2" ·
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us



Chiller Output [MBH]	Fossil Fuel Displaced
17	13%
34	24%
51	34%
68	43%
85	52%
102	60%
119	66%
136	71%
154	75%
171	79%
188	83%
205	85%
222	87%
239	86%
256	87%
273	86%
341	81%
512	62%
682	29%
853	12%
1024	3%
1365	0%
1706	0%
2047	0%
3412	0%

USFS Supervisor's Office - Quincy

WORKBOOK VERSION: 3.7.1

Wood-Fired Heating and Cooling **System Output (MBH)** 750 ORIG. DATE: 17-Jun-13

DRAFT PRELIMINARY SUMMARY COST ESTIMATE **Contact** Earl Ford REV. DATE: 09-Jul-13

NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	EST HRS	INSTALL. EQUIPMENT	INSTALL. MATERIALS	INSTALL. LABOR	TOTAL
I	**CIVIL/STRUCTURAL:**				160	$10,000	$30,000	$20,000	$60,000
II	**MECHANICAL INSTALLATION:**				1776	$30,000	$570,000	$140,000	$740,000
III	**PERMITING**					$0	$10,000	$0	$10,000
IV	**MISCELLANEOUS:**					$10,000	$0	$0	$10,000
V	**ELECTRICAL:**				400	$0	$30,000	$30,000	$60,000
			TOTAL DIRECT COST:		2336	$50,000	$640,000	$190,000	$880,000
VI	**INDIRECT COSTS:**								
	GENERAL CONTRACTOR O&P								$150,000
	ENGINEERING, CONSTRUCTION MANAGEMENT & COMMISSIONING								$100,000
VII	**10% UNLISTED ITEMS ALLOWANCE**								$110,000
VIII	**11% CONTINGENCY ALLOWANCE**								$120,000
			TOTAL CAPITAL COST:						$1,360,000
IX	**ITEMS NOT IN THIS ESTIMATE**								
	COMPLIANCE TESTING								
	ENVIRONMENTAL ENGINEERING								
	STORM WATER SYSTEM								
	ASH OR RESIDUAL DISPOSAL OFF-SITE								
	TAXES NOT INCLUDED								

USFS Supervisor's Office - Quincy

Proforma Project Financial Statement

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us

Project USFS Supervisor's Office - Quincy
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

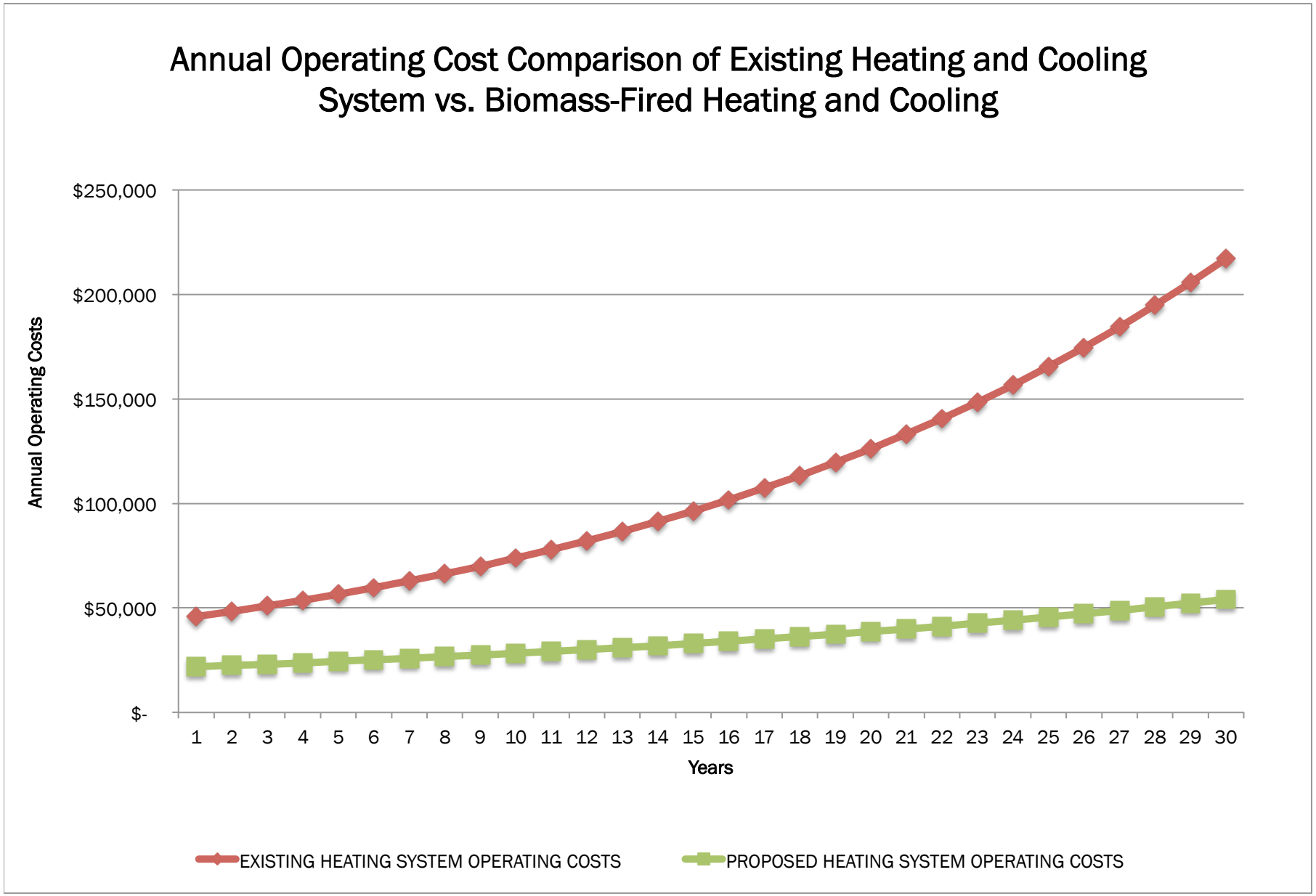
System Description Wood-Fired Heating and Cooling
System Output (MBH) 750
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

DEBT SERVICE		
Total Installation Cost		$ 1,360,000
Grants	0%	$ -
Debt Leverage		0.0%
Project Equity		100.0%
Loan Amount		$ -
Amount of Equity		$ 1,360,000
Annual Rate		5.0%
Term (Years)		30.00

FUEL COSTS	Fossil Fuel	Wood	Electricity
Unit	(mmBtu)	(mmBtu)	(kWhr)
Cost per unit	$26.42	$8.13	$0.17
Escalation Rate	5.8%	2.0%	3.0%

O&M, WOOD	Labor		Electricity
Labor (hrs/wk)	2	Max. electrical draw (kW)	0.5
$/hr	$30	Average draw (kW)	0.3
Wk/yr	40	Annual use (kWhr)	806.9
Total/yr	$2,400	Annual cost, pellet boiler	$136
Ann. increase	2%	Oil boiler, blower, kW	5.0
		Oil boiler, elec. kWh	$0

30 YR ACCUMULATED CASH FLOW	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
EXISTING HEATING SYSTEM OPERATING COSTS														
Existing Heating System Replacment Cost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Projected Heating Oil Cost	$ 39,574	$ 41,870	$ 44,298	$ 46,868	$ 49,586	$ 52,462	$ 55,505	$ 58,724	$ 62,130	$ 65,733	$ 87,139	$ 115,516	$ 153,134	$ 203,002
O&M Cost	$ 1,200	$ 1,224	$ 1,248	$ 1,273	$ 1,299	$ 1,325	$ 1,351	$ 1,378	$ 1,406	$ 1,434	$ 1,583	$ 1,748	$ 1,930	$ 2,131
Projected Cooling Cost	$ 5,100	$ 5,253	$ 5,411	$ 5,573	$ 5,740	$ 5,912	$ 6,090	$ 6,272	$ 6,461	$ 6,654	$ 7,714	$ 8,943	$ 10,367	$ 12,018
TOTAL	**$ 45,874**	**$ 48,347**	**$ 50,957**	**$ 53,714**	**$ 56,625**	**$ 59,699**	**$ 62,946**	**$ 66,375**	**$ 69,996**	**$ 73,822**	**$ 86,640**	**$ 126,207**	**$ 165,431**	**$ 217,151**
PROPOSED HEATING SYSTEM OPERATING COSTS														
Heating Oil Fuel Cost (Peak and Low Load)	$ 3,933	$ 4,162	$ 4,403	$ 4,658	$ 4,928	$ 5,214	$ 5,517	$ 5,837	$ 6,175	$ 6,533	$ 8,661	$ 11,481	$ 15,220	$ 20,177
Wood Fuel Cost	$ 11,576	$ 11,808	$ 12,044	$ 12,285	$ 12,530	$ 12,781	$ 13,037	$ 13,297	$ 13,563	$ 13,835	$ 15,275	$ 16,864	$ 18,620	$ 20,558
O&M Cost	$ 2,400	$ 2,448	$ 2,497	$ 2,547	$ 2,598	$ 2,650	$ 2,703	$ 2,757	$ 2,812	$ 2,868	$ 3,167	$ 3,496	$ 3,860	$ 4,262
Electrical Cost	$ 136	$ 140	$ 144	$ 148	$ 153	$ 157	$ 162	$ 167	$ 172	$ 177	$ 205	$ 238	$ 276	$ 319
Water-Fired Chiller Cooling Costs	$ 3,795	$ 3,871	$ 3,987	$ 4,107	$ 4,230	$ 4,357	$ 4,488	$ 4,622	$ 4,761	$ 4,904	$ 5,685	$ 6,590	$ 7,640	$ 8,857
TOTAL	**$ 21,840**	**$ 22,428**	**$ 23,075**	**$ 23,745**	**$ 24,439**	**$ 25,159**	**$ 25,906**	**$ 26,680**	**$ 27,483**	**$ 28,317**	**$ 32,992**	**$ 38,670**	**$ 45,616**	**$ 54,172**
PROJECT RELATED DEBT														
Beginning Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Principal Repayments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL DEBT PAYMENT	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
ANNUAL OPERATING COST SAVINGS (LOSS)	**$ 24,034**	**$ 25,919**	**$ 27,883**	**$ 29,969**	**$ 32,186**	**$ 34,540**	**$ 37,040**	**$ 39,695**	**$ 42,513**	**$ 45,505**	**$ 63,445**	**$ 87,537**	**$ 119,816**	**$ 162,979**
Cash Investment (equity)	$ (1,360,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Income (cost savings)	$ 24,034	$ 25,919	$ 27,883	$ 29,969	$ 32,186	$ 34,540	$ 37,040	$ 39,695	$ 42,513	$ 45,505	$ 63,445	$ 87,537	$ 119,816	$ 162,979
Net Cash Flow	**$ (1,335,966)**	**$ 25,919**	**$ 27,883**	**$ 29,969**	**$ 32,186**	**$ 34,540**	**$ 37,040**	**$ 39,695**	**$ 42,513**	**$ 45,505**	**$ 63,445**	**$ 87,537**	**$ 119,816**	**$ 162,979**
ACCUMULATED CASH FLOW	$ (1,335,966)	$ (1,310,047)	$ (1,282,164)	$ (1,252,195)	$ (1,220,010)	$ (1,185,470)	$ (1,148,430)	$ (1,108,735)	$ (1,066,222)	$ (1,020,717)	$ (741,495)	$ (354,819)	$ 175,945	$ 899,516


Annual Operating Cost Comparison of Existing Heating and Cooling System vs. Biomass-Fired Heating and Cooling
Annual Operating Costs
$250,000
$200,000
$150,000
$100,000
$50,000
$-
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Years
EXISTING HEATING SYSTEM OPERATING COSTS
PROPOSED HEATING SYSTEM OPERATING COSTS

Supervisor's Office

Scenario 2: Main Buildings (2000, 2001, 2200, 2301), Heating Only

USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Energy Calculations

Bldgs: 2000, 2001, 2200, 2301

Project Wood-Fired Boiler - Main Bldgs
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Heat Only
System Output (MBH) 500
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us
Address 1001 SE Water Ave, Suite 255
Portland, OR 97214

Exisiting fossil fuel consumption (MMBtu/HDD)	0.210	Max. electrical demand (kW)	0.5	Current heating oil use, [gal/yr]	3,500
Existing Furnace Eff.	90%	Average electrical demand (kW)	0.3	Current propane use, [gal/yr]	8,793
Calculated exisiting heat input (MMBtu/HDD)	0.189	Annual use (kWhr)	1065	Current heating oil cost, [$/yr]	$13,125
Efficiency gains (via EEMs)	0%	Estimated reduction in heating oil use	91%	Current propane cost, [$/yr]	$20,927
Wood Boiler Eff.	85.0%	Boiler output, high-fire (MBH)	500	Projected wood fuel use, [tons/yr]	102
Heating oil cost, $/gal.	$3.75	Boiler output, low-fire (MBH)	100	Projected propane use, [gal/yr]	1,217
Propane cost, $/gal.	$2.38	Average boiler output (MBH)	336	Projected wood fuel use, [$/yr]	$10,188
Electricity cost, $/kWhr	0.17	Wood MC, wet weight basis	25%	Projected heating oil use, [$/yr]	$2,896
Wood fuel cost, $/green ton	$100.00	Energy of Wood, mmBtu/ton, LHV	12.3	Projected electricity cost, [$/yr]	$85
Fossil fuel cost, $/mmBtu	$26.42	Energy of heating oil, Btu/gal, HHV	139000	Operating hours per day	12
Wood fuel cost, $/mmBtu	$8.13	Energy of propane, Btu/gal, HHV	92000	Operating hours, yr	3168

Month	Applicable Heating Degree Days [HDD]	Current gross fossil energy consumption, [MMBtu]	Current net space heat energy input [MMBtu]	Projected net space heat input after EEMs [mmBtu/mo]	Projected gross wood energy consumption, [MMBtu]	Projected gross fossil energy consumption, [MMBtu]
September	163	34	31	31	33	9
October	479	101	91	91	97	14
November	793	167	150	150	161	17
December	942	198	178	178	192	17
January	921	194	174	174	187	14
February	762	160	144	144	155	13
March	737	155	139	139	150	10
April	541	114	102	102	110	6
May	328	69	62	62	67	4
June	231	49	44	44	47	3
July	140	29	27	27	29	2
August	126	26	24	24	26	0
Yearly Total, or Avg.	6162	1,295	1,166	1,166	1,253	109

Net fossil energy savings, [MMBtu/yr] **1,186**

PRELIMINARY

DRAFT- FOR COMMENT

USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Energy Calculations

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Location Plumas, OR
Contact Earl Ford
Date 7/9/13

System Description Heat Only
System Output (MBH) 500
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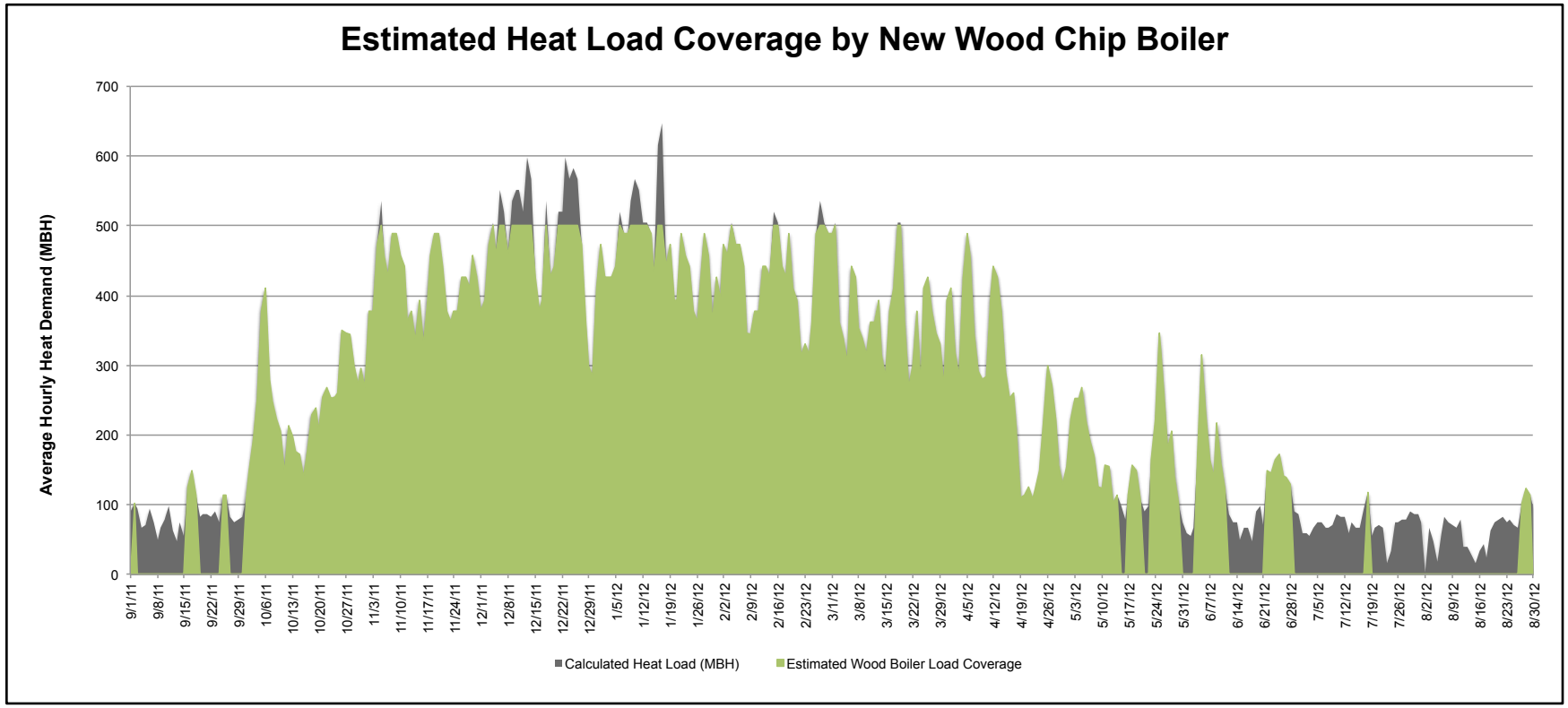
Workbook Version 3.7.1

Contact Andrew Haden
Phone (503) 706-6187



USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Energy Calculations

Project Wood-Fired Boiler - Main Bldgs
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

Boiler Option Heat Only
System Output (MBH) 500
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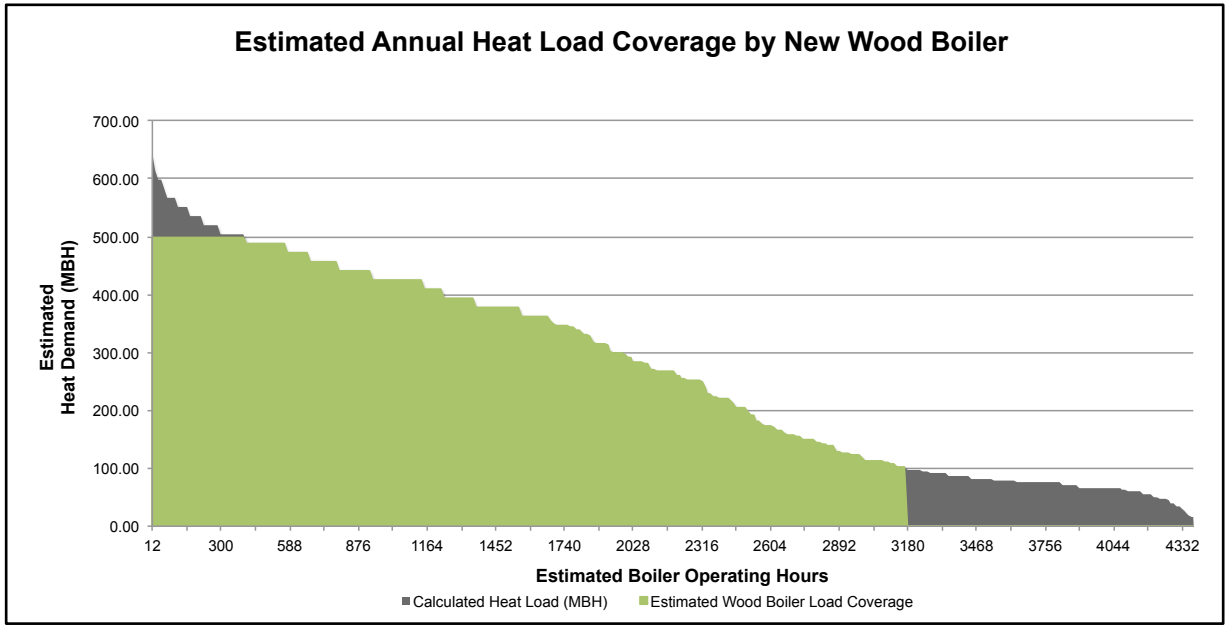

Boiler Output [MBH]	Fossil Fuel Displaced
34	13%
89	31%
136	44%
177	53%
205	59%
266	71%
341	82%
500	91%
750	88%
1024	85%
1365	76%
1842	61%
2457	18%
3241	0%
4265	0%
5459	0%
7165	0%
10236	0%
13648	0%
17060	0%
20472	0%
23884	0%
27296	0%
30708	0%
34120	0%

USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Energy Calculations

Project Wood-Fired Boiler - Main Bldgs
Location Plumas, OR
Contact Earl Ford
Date 7/9/13

Boiler Option Wood-Fired Boiler - Heat Only
System Output (MBH) 500
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.1

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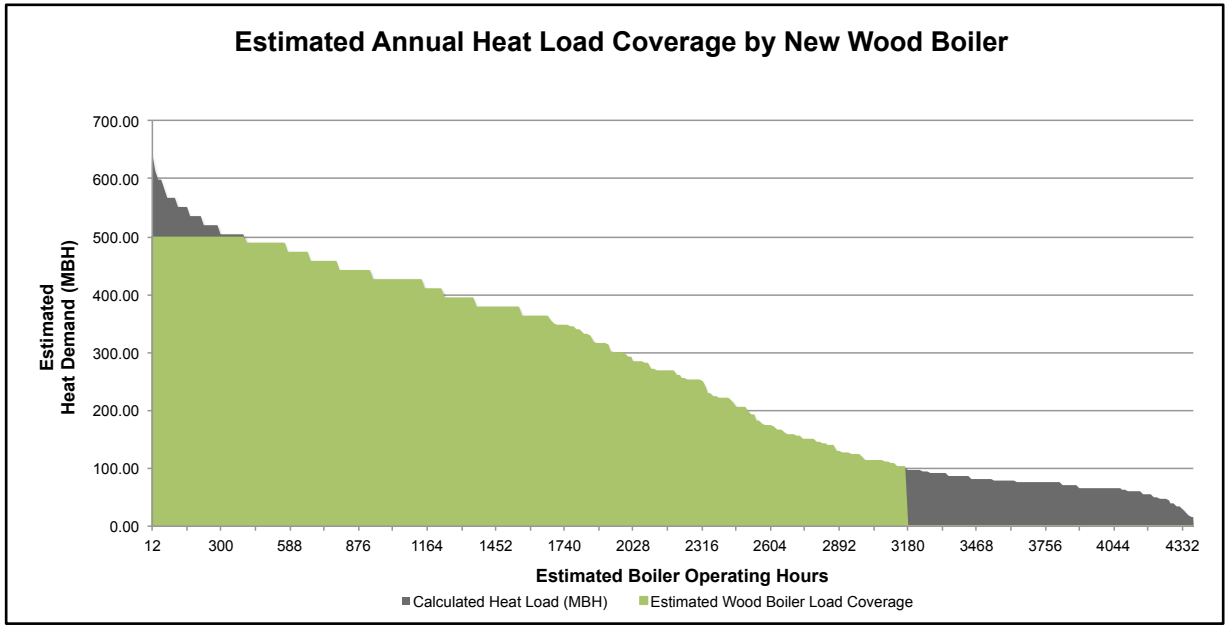

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USFS Supervisor's Office - Quincy

Wood-Fired Boiler - Main Bldgs

Heat Only: Bldgs: 2000, 2001, 2200, 2301 **System Output (MBH)** 500

DRAFT PRELIMINARY BUDGETARY SUMMARY COST ESTIMATE **Contact** Earl Ford

WORKBOOK VERSION: 3.7.2
ORIG. DATE: 17-Jun-13
REV. DATE: 23-Jul-13

NO.	ITEM DESCRIPTION	UNIT	QTY	UNIT COST	EST HRS	INSTALL. EQUIPMENT	INSTALL. MATERIALS	INSTALL. LABOR	TOTAL
I	**CIVIL/STRUCTURAL:**				160	$10,000	$30,000	$20,000	$60,000
II	**MECHANICAL INSTALLATION:**				1144	$30,000	$330,000	$80,000	$440,000
III	**PERMITING**					$0	$10,000	$0	$10,000
IV	**MISCELLANEOUS:**					$10,000	$0	$0	$10,000
V	**ELECTRICAL:**				320	$0	$30,000	$30,000	$60,000
			TOTAL DIRECT COST:		1624	$50,000	$400,000	$130,000	$580,000
VI	**INDIRECT COSTS:**								
	GENERAL CONTRACTOR O&P								$100,000
	ENGINEERING, CONSTRUCTION MANAGEMENT & COMMISSIONING								$70,000
VII	**10% UNLISTED ITEMS ALLOWANCE**								$70,000
VIII	**11% CONTINGENCY ALLOWANCE**								$80,000
			TOTAL CAPITAL COST:						$900,000
IX	**ITEMS NOT IN THIS ESTIMATE**								
	COMPLIANCE TESTING								
	ENVIRONMENTAL ENGINEERING								
	STORM WATER SYSTEM								
	ASH OR RESIDUAL DISPOSAL OFF-SITE								
	TAXES NOT INCLUDED								

USFS Supervisor's Office - Quincy

Proforma Project Financial Statement

Contact Andrew Haden
Phone (503) 706-6187
Email andrew@wisewood.us

Project Wood-Fired Boiler - Main Bldgs
Location Plumas, OR
Contact Earl Ford
Date 7/23/13

System Description Heat Only: Bldgs: 2000, 2001, 2200, 2301
System Output (MBH) 500
Fuel Type Conditioned Forest Biomass (<2" <35%MC)
Workbook Version 3.7.2

DEBT SERVICE		
Total Installation Cost		$ 900,000
Grants	0%	$ -
Debt Leverage		0.0%
Project Equity		100.0%
Loan Amount		$ -
Amount of Equity		$ 900,000
Annual Rate		5.0%
Term (Years)		30.00

FUEL COSTS	Fossil Fuel	Wood	Electricity
Unit	(mmBtu)	(mmBtu)	(kWhr)
Cost per unit	$26.42	$8.13	$0.17
Escalation Rate	5.8%	2.0%	3.0%

O&M, WOOD	Labor		Electricity
Labor (hrs/wk)	2	Max. electrical draw (kW)	0.5
$/hr	$30	Average draw (kW)	0.3
Wk/yr	40	Annual use (kWhr)	1065.1
Total/yr	$2,400	Annual cost, pellet boiler	$179
Ann. increase	2%	Oil boiler, blower, kW	5.0
		Oil boiler, elec. kWh	$0

30 YR ACCUMULATED CASH FLOW	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 15	Year 20	Year 25	Year 30
EXISTING HEATING SYSTEM OPERATING COSTS														
Existing Heating System Replacment Cost	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Projected Heating Oil Cost	$ 34,231	$ 36,216	$ 38,317	$ 40,539	$ 42,890	$ 45,378	$ 48,010	$ 50,794	$ 53,740	$ 56,857	$ 75,373	$ 99,918	$ 132,456	$ 175,590
O&M Cost	$ 1,200	$ 1,224	$ 1,248	$ 1,273	$ 1,299	$ 1,325	$ 1,351	$ 1,378	$ 1,406	$ 1,434	$ 1,583	$ 1,748	$ 1,930	$ 2,131
TOTAL	**$ 35,431**	**$ 37,440**	**$ 39,565**	**$ 41,812**	**$ 44,189**	**$ 46,703**	**$ 49,361**	**$ 52,173**	**$ 55,146**	**$ 58,291**	**$ 68,857**	**$ 101,666**	**$ 134,386**	**$ 177,721**
PROPOSED HEATING SYSTEM OPERATING COSTS														
Heating Oil Fuel Cost (Peak and Low Load)	$ 2,880	$ 3,047	$ 3,224	$ 3,411	$ 3,609	$ 3,818	$ 4,039	$ 4,274	$ 4,521	$ 4,784	$ 6,341	$ 8,407	$ 11,144	$ 14,773
Wood Fuel Cost	$ 10,188	$ 10,392	$ 10,599	$ 10,811	$ 11,028	$ 11,248	$ 11,473	$ 11,703	$ 11,937	$ 12,175	$ 13,443	$ 14,842	$ 16,386	$ 18,092
O&M Cost	$ 2,400	$ 2,448	$ 2,497	$ 2,547	$ 2,598	$ 2,650	$ 2,703	$ 2,757	$ 2,812	$ 2,868	$ 3,167	$ 3,496	$ 3,860	$ 4,262
Electrical Cost	$ 179	$ 184	$ 190	$ 196	$ 201	$ 207	$ 214	$ 220	$ 227	$ 233	$ 271	$ 314	$ 364	$ 422
TOTAL	**$ 15,647**	**$ 16,071**	**$ 16,510**	**$ 16,965**	**$ 17,435**	**$ 17,923**	**$ 18,429**	**$ 18,953**	**$ 19,497**	**$ 20,061**	**$ 23,222**	**$ 27,058**	**$ 31,755**	**$ 37,549**
PROJECT RELATED DEBT														
Beginning Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Principal Repayments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Interest Payments	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Principal Balance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
TOTAL DEBT PAYMENT	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
ANNUAL OPERATING COST SAVINGS (LOSS)	**$ 19,784**	**$ 21,369**	**$ 23,055**	**$ 24,848**	**$ 26,754**	**$ 28,779**	**$ 30,932**	**$ 33,220**	**$ 35,650**	**$ 38,231**	**$ 53,735**	**$ 74,607**	**$ 102,631**	**$ 140,172**
Cash Investment (equity)	$ (900,000)	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -				
Income (cost savings)	$ 19,784	$ 21,369	$ 23,055	$ 24,848	$ 26,754	$ 28,779	$ 30,932	$ 33,220	$ 35,650	$ 38,231	$ 53,735	$ 74,607	$ 102,631	$ 140,172
Net Cash Flow	**$ (880,216)**	**$ 21,369**	**$ 23,055**	**$ 24,848**	**$ 26,754**	**$ 28,779**	**$ 30,932**	**$ 33,220**	**$ 35,650**	**$ 38,231**	**$ 53,735**	**$ 74,607**	**$ 102,631**	**$ 140,172**
ACCUMULATED CASH FLOW	$ (880,216)	$ (858,847)	$ (835,792)	$ (810,944)	$ (784,191)	$ (755,411)	$ (724,479)	$ (691,259)	$ (655,610)	$ (617,379)	$ (381,566)	$ (52,741)	$ 401,084	$ 1,022,492