Heat Pump

Mitsubishi MXZ-4C36 ductless multi-zone outdoor unit
4 MSZ indoor units 2 upstairs and 2 downstairs 15, 9, 6, 6 kBTU/hr

Ratings
36,000 BTU/hr Cooling
34,000 BTU/hr Heating @ 17 F
SEER = 19.1
EER = 14.0

Heating Efficiency
HSPF = 11.3 BTU/watt-hour, COP = 3.3 ie: 3.3 times more efficient than resistance heaters such as electric baseboard heaters.

Installer
Home Energy Products, Belmont, NH

This is our primary heating system. We do not have oil or propane. We do have a small wood stove.

House

built new in 2016/17
all-electric
1200 sq. ft. main level + 1200 sq. ft. walkout basement = 2400 sq. ft. insulated living area
well insulated
air-sealed
active HRV ventilation
pretty good windows (Intus)
passive solar design and active solar PV

Air Conditioning

My focus here is on heating. This is my only commentary on air-conditioning:

This is an excellent air conditioner. We have been able to power it 100% directly from our solar PV array. If the sun is not shining we have not needed it. We use thermostat setbacks to prevent it from running past sundown in the summer. We turn it on and off manually as needed.

Energy Monitor

I have a single channel Efergy TPM (True Power) energy and power meter. It has two current transformers and a voltage connection for monitoring 240 VAC circuits such as the heat pump. This is a consumer level product and it makes no specific claims on accuracy. It is claimed that it reports real power and not apparent power. This appears to be correct. Many consumer energy monitors do not report real power. In comparing it with our utility meter, it tends to read about 5 to 10% low. I have made corrections based on that calibration in the following data.

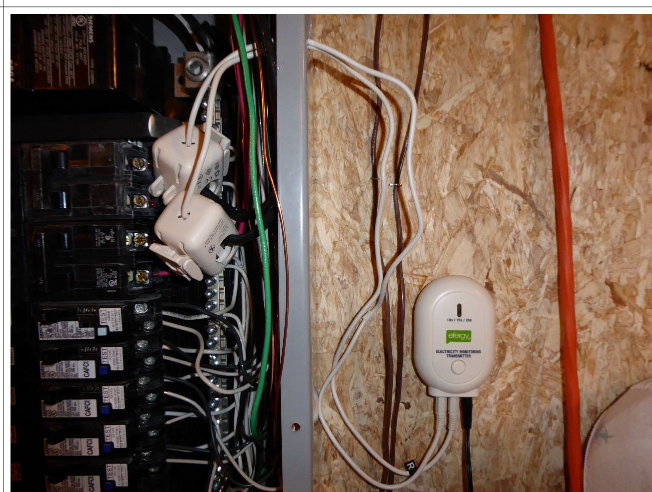
Outdoor Unit

Indoor Unit

Branch Box

Thermostat

EfergyTPM Energy/Power Monitor



Efergy Sensors and Transmitter

<u>Winter Heat Pump Energy Usage Data</u>

Billing Period	Usage (kWh/day)	% of total usage	Avg. Temp.	Cost (HP only)
Nov '17	32 E	70 E	---	$161 E
Dec '17	**50 E**	78 E	**11.8 E**	**$262 E ***
Jan '18	30.8	67.8	24.5	$151
Feb '18	23.8	63.3	32.9	$109
Mar '18	17.5	59.1	34.1	$ 86
Apr '18	14.0	50.0	45.1	$ 65
Season				$834
Nov '18	15 E	51 E	31.0	$ 76 E
Dec '18	18.0	55.6	26.2	$ 94
Jan '19 - 1st 21 days	27.8	67.4	17.5	$141 Ext.

Notes:

E = Estimate, or not directly measured
Ext = Extrapolated to full month

Comments

- ***** Dec '17 was very cold, but I only have partial temperature data. We were running the HRV all the time which brings in cold air. We have changed our practice on this since.
- We installed setback thermostats in late January 2018.
- We are being more proactive in managing the heat pump this winter than last, and are saving energy. This means manually turning zones or the whole system off and using time-based automatic setbacks at night and during the day.
- This data is net of passive solar heating on sunny days, use of our wood stove, and losses caused by the same windows that provide passive solar heat.
- Experience is paying off in lower heating bills so far this winter.
- This month (Jan '19) 4 hrs AM, 4 hrs PM, 16 hrs deep setback (mostly standby).
- Electricity prices are from New Hampshire Electric Co-op bills.

Observations

- **Expensive Efficiency:** We believe that our heat pump is efficient, but the "fuel" is very expensive, so this is not the cheapest way to heat your house. However it may be the most affordable way to heat *with electricity.*

- At **very low temperatures** our heat pump becomes less efficient and less powerful. At sub-zero temperatures it starts using a built-in resistance heater to assist the pump and the power draw becomes extremely high. I have seen it draw over 7000 watts.

- Our system came with 4 **remote controls**. These allow you to manually control the operating mode and the current but do not have any programmability. They are perhaps fine for single zone auxiliary systems (except for the next point below) but do not seem to be ideal for a multi-zone primary heating system.

- **Heat Pooling**: Heat would pool around our indoor units that were mounted below an insulated ceiling causing the unit to cycle on and off. Our solution was to replace the remotes and the internal thermostats with external wireless, progammable thermostats. These are made by Honeywell and work well, but cost about $250 each.

- **Low Temperature Heat:** The heat pump produces heat at around 100 degrees F. It takes longer to warm the house than combustion heat systems.

- **Low setpoint**: We have found that it is much more expensive to maintain 68 degrees inside than 65. This may say more about our house than it does about the heat pump. Some people might not find this acceptable.

- **Continuous operation**: We have found that if we leave the heat pump on (in heat mode) continuously with a minimal setback, it tends to run most of the time apparently in an effort to maintain a fairly precise temperature. During a 4-day experiment, it used 33 kWh/day (Avg. temp 21F). Using deep setbacks, or even manually turning the system on & off saves energy but is inconvenient and allows the inside temperature to fluctuate more.

- **Standby Power:** When the outside temperature is below freezing and one or more zones is in heat mode, but none are calling for heat, our heat pump will still draw about 200 watts. During long setback periods, this wastes a lot of energy. A solution is to manually turn the whole system off (at the thermostats) which can be very inconvenient. The thermostats cannot be programmed to turn the system back on. This may be an installation or configuration issue, but the installer has been unable to help.

- Our heat pump is **clean and quiet.** There are no funny smells and we can barely hear it. If I didn't obsess over energy usage & cost it would be nearly ideal. But since I do, and am willing to cut & dry firewood myself, our **wood stove** is seeing a lot of use. It is also handy to have a heat source that does not require electricity when the power goes out.