The Hynds Building

1608 Capitol Ave., Cheyenne, Wyoming 82001

ASHRAE Level II Building Energy Audit Report

December 2, 2016

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Executive Summary & Project Description

In November 2016, Cheyenne Development Partners, LLC retained the services of Sustainably Built, LLC (SB) to perform an ASHRAE Level II Energy Audit on the Hynds Building, located at 1608 Capitol Ave., Cheyenne, Wyoming, in support of an Energy Efficiency, Energy Audit and Retrofit Grant from the US Department of Agriculture. This report describes the findings and recommendations developed during this energy audit. During the course of an on-site inspection, as well as a review of the plan drawings and planned mechanical and lighting systems upgrades for the building, potential energy conservation measures (ECMs) have been identified. We have compiled these measures with input from the project's owners, architects and engineers.

The Hynds Building is a five-story office building located in the downtown business district of Cheyenne. The building was constructed in or about 1920, and other than the ground floor it has been unoccupied since 1986. The building includes a basement level and five floors above grade for a combined 52,620 SF of floor space, including the basement; without the basement the building area is 43,850 SF. Most of the ground floor level is oriented towards retail usage while the upper four floors are best suited for offices or other professional space. During the renovation a stair and elevator core will be added to the rear NW corner of the building, adding around 420 SF to the building's footprint with associated landings and stairs for each floor; otherwise there will be no additional square footage added during the project.

Cheyenne, Wyoming Climate Zone and Code Adoption Status

Cheyenne is in IECC Climate Zone 6B and has adopted the following version of the code for these code categories:

- Building Codes: 2015 IBC (Commercial), 2015 IRC (Residential)
- Fire Codes: 2015
- Plumbing: 2015
- Fuel Gas Code: 2015
- Electrical: 2014 National Electrical Code
- Accessibility: 2009 ICC A117.1
- Energy Code: 2015 IECC
- Existing Building Code: 2015
- Radon Control: None adopted (use IRC, Appendix F)

Building Shell Characteristics (approximate)

- Total exposed above-grade wall area: 25,380 SF. Steel frame, brick & masonry walls. Uninsulated.
- Glazing area by window types:
    - Single pane (floor 2 – 5 single-hung): 6,000 SF
    - Double pane (ground floor "storefront"): 965 SF
    - Stained glass (ground floor above storefront): 350 SF

- Roof area: 8,770 SF. Uninsulated.
- Floor surface area exposed to outdoor conditions: None.
- Above-grade wall area common with other conditioned building: None
- Foundation (below grade) area: 3,965 SF. Rubble & concrete, some cinder block. Uninsulated.

Existing Building Conditions

The building was inspected and assessed on November 17, 2016 by Sustainably Built to determine the existing condition of the building, including:

- Insulation location and types (if any)
- Window types
- Mechanicals
- Lighting
- Other relevant data that would impact the future energy efficiency of the building

The inspection revealed a building constructed with little regard to energy efficiency, as would generally be expected for buildings of its era. The interior is in remarkably good condition considering that most of it has been unoccupied for three decades. The building is constructed of a steel frame with masonry and brick exterior walls with glazed terra cotta tiles on the South and East street-side exteriors and brick on the North alley and West exteriors. All of the exterior walls are uninsulated

The top-floor ceiling is uninsulated as well. The ceiling of the top floor has a large space above it (essentially an attic) approximately 6 to 8 feet high, with variation due to slope of roof surface above. This space could easily be accessed for the purposes of adding insulation and/or performing air sealing from underneath the roof.

The foundation is mostly of concrete and rubble construction, with some newer cinder blocks shoring up some sections of the foundation. There are multiple areas with evidence of water intrusion into the basement.

The majority of the 240+ windows in the building, with the exception of the first floor, are single hung, single pane and metal framed and are likely original to the building. They are in fair condition, though a few are broken or missing. It is not known whether any of the upper floor windows are still operable but none were found to be; all of the ones inspected were painted shut or otherwise unable to be opened. The first floor of the building does have newer windows installed which are double-paned "storefront" type windows with a low-E coating. Because they are metal framed and contain single pane glass, they are highly inefficient windows.

Except for the ground floor, the building is lacking any heating, cooling or ventilation systems, nor is it currently served by any utilities, including electricity, gas, phone, water or sewer services. While the upper floors of the building contain cast-iron radiators and baseboard heaters and were thus obviously heated with a radiant system in the past, there were no heating systems (boilers), nor obvious evidence of a district steam heating system which apparently served downtown Cheyenne for some time in the past, still left in the building for all but the ground floor.

On the ground floor there are five high-efficiency 95 AFUE Lennox gas furnaces which were installed in 2011. These units provide heat to the semi-occupied first floor spaces. This floor has one permanent occupant, an art gallery/retail with semi-regular business hours, which occupies about 15% of the first floor space. The majority of the first floor is used occasionally for events but is unused most of the time. The first floor does have the typically expected utility services including water, sewer, electrical and gas.

Recent Building Upgrades

While five of the six floors of the building are vacant and have been unoccupied for decades, the ground floor is connected to utility services and has had some relatively recent upgrades to make the space usable. These include new windows as well as heating and ventilation systems, all installed in 2011. The windows are Kawneer 451T thermally broken "storefront" type windows, with 1" insulated double pane Low-E glazing. The heating system for this floor consists of five Lennox 95 AFUE forced air furnaces, and there are three separate HRV (Heat Recovery Ventilators) units providing fresh air to the space of the first floor via the ducts for the heating system. The furnaces are connected to programmable thermostat(s) located in various zones of the space. However, apart from the art gallery, much of the first floor could be considered a single zone since it is more or less a single contiguous space. The plumbing on this floor has also been modernized to provide for two rest rooms and running water and a hot water heater.

While the art gallery space does have permanent fixture lighting, the rest of the ground floor has no permanent lighting, using floor lamps and other plug-in lights hanging from the ceilings to provide illumination. Some of the original fluorescent light fixtures remain installed within the space, but these were inoperable and are likely connected to the long-defunct original electrical system of the building.

Energy Efficiency Measures Clarification

Typically an energy audit of this type would analyze historical energy usage and would outline potential energy savings measures, quantifying the savings that could be realized if such measures were implemented. However, because the building has been largely unoccupied for three decades there is no meaningful historical energy usage data that can be used for a whole-building energy analysis. Further, except for than the ground floor, all mechanical, plumbing and lighting systems have been removed or are inoperable, and there are no services (electrical, plumbing, gas, water, sewer, etc.) available in the building.

Because most of the empty building currently uses no energy at all this analysis will not focus on what could be improved compared to the status quo situation, as would typically be the case for an ASHRAE Level II Energy Audit. Rather, the analysis will focus on bringing the building back to life in the most reasonable, energy efficient and cost effective ways.

Today's building and energy efficiency codes dictate a significantly more energy efficient profile for the building compared to what would have been required in the past during a gut renovation of a building of this type. Compared to even a decade ago, the choices that will affect energy efficiency and energy consumption during this renovation are really a list of "good" and "better" measures. As such, this analysis will identify "baseline" improvements focused on simply getting the building to meet code to the point where it can be occupied again, as well as "above and beyond" improvements that would make for a more efficient and comfortable building compared to its minimum code baseline.

The building presents multiple energy savings opportunities with varying degrees of payback, return on investment and capital outlay. In general, it is recommended to perform the high priority, low capital improvement projects first. The two distinct types of practical measures are:

Operations and Maintenance Measures.

Many operation and maintenance measures can be implemented without significant cost and should be planned for and /or installed during the renovation. These measures will improve the energy efficiency of the building beyond code requirements, with little cost to the owners or tenants. Items such as scheduled filter changes, water-saving fixtures and lighting control scenarios lead the list items that will improve building performance in both the short and long terms.

Capital Improvement Measures.

Of the capital improvement measures, the higher capital cost items are also the items that would have the largest impact as the building transitions back to full occupancy, such as installing highly efficient heating and cooling systems, insulating the walls and roof, improving or replacing windows, and aggressive air sealing work.

Energy Conservation Recommendations

There are a number of low cost or no cost energy conservation measures that should be implemented during the renovation, including:

- Automated lighting systems with occupancy sensors
- High-efficiency lighting fixtures (primarily LED)
- Programmable ("set back") thermostats paired with occupancy sensors
- Low-flow water fixtures (WaterSense labeled)

Beyond the above measures, the first priority in bringing this building up to modern standards of efficiency must be to address the building's shell. This includes the ceiling / roofs, walls, windows and the foundation. This also would include aggressive air sealing work to reduce leaks in the shell including around windows, doors and utility penetrations. By addressing the shell first savings can be realized elsewhere by reducing the building's heating and cooling loads, requiring smaller and less expensive mechanical systems.

Walls

It appears that this building will need to comply with the 2015 IECC code for new construction with regards to the wall insulation, because it does not have any "existing wall cavities" to fill with insulation. Assuming that the Building Department agrees with this interpretation, the code dictates that the wall insulation for a mass wall be R-13 continuous (not stud cavity). This means that the R-13 insulation must be between the masonry wall and the interior wall studs. If rigid foam is used, then for XPS (extruded polystyrene) foam this would be at least 2 ¾" of foam; 2.5" is not quite sufficient. EPS (expanded polystyrene) foam would require 3 ¼" minimum to reach R-13. For that reason, closed cell spray foam may be preferable for its higher R-value per inch (R-6.5/in vs R-5/in for XPS or R-4/in for EPS) and ease of install, including that it can be sprayed onto the exterior wall after the interior framing wall has been built since the foam will expand into the space behind the studs. If closed cell foam is used, then only 2" would need to be applied to meet R-13.

Also, to preserve floor area it might be possible to use 2x2 studs to frame the walls rather than 2x4 studs to minimize the amount of interior floor space that will be taken up by the interior wall assembly.

It also should be highlighted that the walls of the building extend above the ceiling of the top floor into the attic cavity between that floor's ceiling and the bottom of the roof assembly. Because the ceiling of the 5th

floor is no more than a relatively thin layer of uninsulated lath and plaster or similar material, heat from the building will be lost through this ceiling into the attic above. For that reason, it is important to insulate the exterior walls of this unoccupied cavity with insulation of the same R-value as the rest of the interior walls of the building. Since there are no interior walls in the attic, we recommend that a 2" closed cell spray foam treatment for the walls in this area be used as it would be less labor intensive to install compared to rigid foam.

Windows:

The Hynds building contains three distinct types of windows – the operable sash windows of floors 2 – 5, the "storefront" windows of the first floor, as well as a strip of stained-glass windows above the first floor storefronts. The storefront windows are relatively modern and in good condition and replacement or repair is not recommended. As such, the distinction should be made that the recommendations below are being made for the old sash windows on floors 2 – 5. The stained glass windows are considered separately.

There are generally two options for addressing the windows in this building: installing new windows or rehabilitation of existing windows with added storm windows (a third scenario might be a combination of these two options.)

Option 1) Install new windows: There are roughly 220 old single-pane, metal-framed sash type windows in the Hynds building. Replacing them is not a minor consideration but would almost certainly result in the best energy performance. New fenestration would be high-performing, with a U-factor (per 2015 IECC) of .38 or lower. In practice, a U-factor of .30 or lower is very common today. Another potential benefit of new replacement windows is that they could be operable, meaning that individual occupants would be able to open or close their windows to adjust their comfort rather than relying on mechanical cooling, assuming the outside temperatures are comfortable.

Option 2) Rehabilitation / storm windows: Rehabilitation of the existing windows would likely be the preferable option from the perspective of preserving the historical aspect and character of the building. However, depending on the level of rehabilitation necessary based on the condition of the windows (it might prove just as costly or more so compared to window replacement because of the amount of skilled labor necessary to rehabilitate around 220 individual windows. Factoring into the rehabilitation equation is that the window frames are metal, which might complicate rehabilitation since metal is not a terribly common historical window frame material for windows of this type – most are wood. Further, adding a high-performing storm window – presumably an interior storm window – will add additional cost to the windows.

The entire rehabilitated window assembly + storm can probably perform nearly as well as new windows. However, because of the storm window these rehabilitated windows would likely be inoperable, which would negate the advantage of simply being able to open a window to regulate individual room temperatures and provide fresh air. A possible solution would be to have a selection of windows restored to operable, with storm windows seasonally installed and removed by building maintenance.

Because both options – new windows or rehabilitation + storm windows – will result in dramatic improvements to the building's comfort and energy efficiency, the decision will likely come down to 1) window replacement vs. rehabilitation budgets and 2) the need or desire to have operable windows.

Stained glass windows between first and second floor: There is a strip of stained glass above the first floor storefront windows. These windows are in very poor condition with many of them broken or missing. If the decision is made to restore or rehabilitate these windows, we recommend that they become a decorative feature only rather than the actual window by installing them in front or behind a new high-performance double-paned window, or possibly fully insulating behind them. Otherwise, if they are to be replaced we recommend double-paned low-E windows, which can include a decorative insert to approximate the look of the existing stained glass.

Roof:

The roof is a flat roof (slightly sloped for drainage) with a large attic space between it and the ceiling of the 5th floor of the building. As far as could be determined without disturbing the waterproof roof membrane, the roof is uninsulated, which would be in line with the findings throughout the rest of the building. During the renovation the roof can be insulated in one of two ways:

Above the deck: Insulate above the roof deck with rigid foam. This would be the easiest method of insulating the roof, though the foam – which will need to be at least 6 inches of XPS to meet R-30 – will make the roof less accessible and will cause it to be more complicated to install any structures or equipment on the roof, such as solar panels and HVAC equipment. The foam insulation is sturdy enough to walk on, but will likely make structural bracing such as those necessary for solar panels more difficult to install.

Below the deck: It appears possible to insulate underneath the concrete beams that make up the structure of the roof. Because the membrane of the roof deck itself would not have any insulation immediately underneath it, the roof surface would remain sturdier and more accessible and would make the installation of solar panels or future uses such as a roof-top deck easier to accomplish. If this were the route taken we would strongly recommend using closed cell spray foam to insulate the bottom of the roof structure. To reach R-30 approximately 5 inches of spray foam would be required.

Foundation

The foundation is uninsulated. Although below-grade foundations are less of an energy penalty compared to above-grade walls or roofs, there will still be a benefit from insulating the perimeter of the foundation. This can be done with either closed cell spray foam, or rigid foam. The latter option will be more challenging to install, but may be more cost effective.

Lighting

We recommend installing 100% HE (high efficiency) lighting in the building. Where possible these should be LED lights, as these last much longer and use less energy than fluorescent lighting. However, where not applicable or available, high-efficiency fluorescent lighting should be used. Lighting in all common areas such as corridors, storage rooms, basement, etc. should be fitted with occupancy sensors.

Electrical

Since an entirely new electrical system will be installed, a best-practice energy efficiency measure that can be implemented during the installation of the new system is a combination of always-on outlets and outlets controlled by a master switch which can be turned off. This allows equipment that always need to be on such as servers, phone systems, etc. to remain on, while equipment that does not need to stay on such as lamps, monitors, personal space heaters, etc. can be turned off with one switch, or possibly on a timer.

Domestic hot water

A hot water circulating pump on a timer is recommended to match the buildings operating hours. This will prevent the service hot water system from heating water during times that the building is unlikely to be occupied. We also strongly recommend insulating all hot water pipes with pipe-wrap insulation.

The following narrative is excerpted from the description of the hot water systems as proposed by **The Consulting Engineering Group (The CE Group),** the MEP engineer. This system matches the type of systems we would be recommending, as such, no further recommendations are made here.

> Water heater will be set at 120 degrees F. to serve public restrooms. A hot water circulating pump with a programmable time clock and piping for this system will be provided. Domestic water heater will be a side arm heater supplied from the main hydronic boiler loop. Provide (2) 120 gallon storage tanks … Domestic hot water and hot water circulating copper piping will be insulated per insulation table under HVAC Systems description.

New HVAC Systems Summary:

The following narrative is copied directly from the description of the HVAC system as proposed by **The Consulting Engineering Group (The CE Group),** the MEP engineer. Because the systems specified are significantly more efficient than a code required system, no further recommendations are made here. The narrative is reproduced here in order to document the type of HVAC systems that are planned for the building:

> The first level will be served by air handlers located in the basement with water cooled DX coils. There will be four units, one to serve the public area, and one to serve each of the first floor office/retail spaces. Distribution will be floor supply around the perimeter, and sidewall/ ceiling supply in the core of the space. The supply mains for the core will be disguised by being chased along walls or columns. The public space is estimated to require a 10-ton unit, and each office/retail unit will be approximately 5 tons. The perimeter of each space will be supplemented with pedestal type baseboard heaters under the windows, fed from the basement below.

> Levels 2 through 5 will be served by the Mitsubishi City Multi Water Source VRF (variable refrigerant flow) Heat Recovery System. City Multi Water Source heat pumps will be used for a total VRF capacity of approximately 55 tons. Each space will be served by a fan coil (ducted when concealed in a soffit, and ceiling cassette when in a dropped ceiling). There will be three main refrigerant riser locations, with a BC valve box on each floor, refer to M&P schematic equipment layout. Each fan coil will have a thermostat, providing individual temperature control to each space. The heat recovery system also allows simultaneous heating and cooling of different zones to provide maximum comfort to all occupants.

> Ventilation air will be ducted from two horizontal outdoor air units with water source heat pumps - DOA (dedicated outdoor air) units to be located on the roof. Mains will be routed down the light wells (that will be concealed architecturally). Each O.A. main will deliver air

to two points in the corridor of each floor, pressurizing the building and permeating each space with fresh air. Door undercuts and transfer air grilles are being considered for a means to transfer air from the corridor to each individual space. For the conference rooms on the 5th level, ventilation air will likely be ducted to each space, with ducts routed through the attic. This concept is still developing.

An approximate 75 ton (225 GPM) fluid cooler will serve the cooling needs of the VRF system. It is proposed that the fluid cooler be located on the roof of the new stair core so that the structure can be designed to support the equipment load. High efficiency injection boilers (located in the basement) will maintain the condenser loop temperature to serve the heat pump system. The boilers will be capable of a high turn down rate to respond to fluctuating loads of the building.

Chases will need to be coordinated for the flues and combustion air ducts for equipment in the basement. Preliminary chases are coordinated for the distribution of refrigerant piping, new plumbing piping, and exhaust ducts, refer to M&P schematic equipment layout.

All new equipment, Fluid Coolers, Boilers, Pumps, Air Handling Units, fan coil units, DOA units, will all be high efficiency type with VFD's, ECM's, 20:1 turndown condensing burners that will all be controlled from a new Direct Digital Control system communicating with a central BAS.

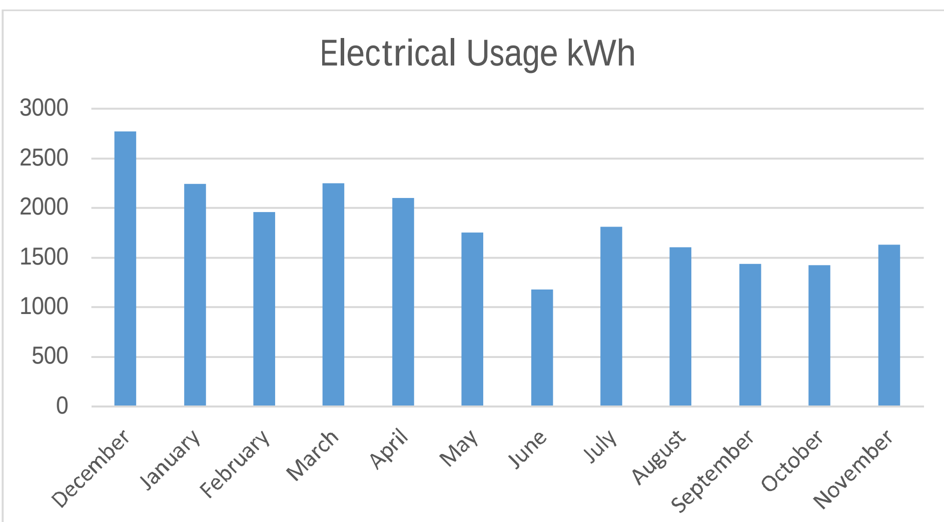
Utility Consumption Information

Historical Utility Usage Past 12 Months

Energy Use by Month – Ground Floor Only

Electricity – Kilowatt Hours, kWh

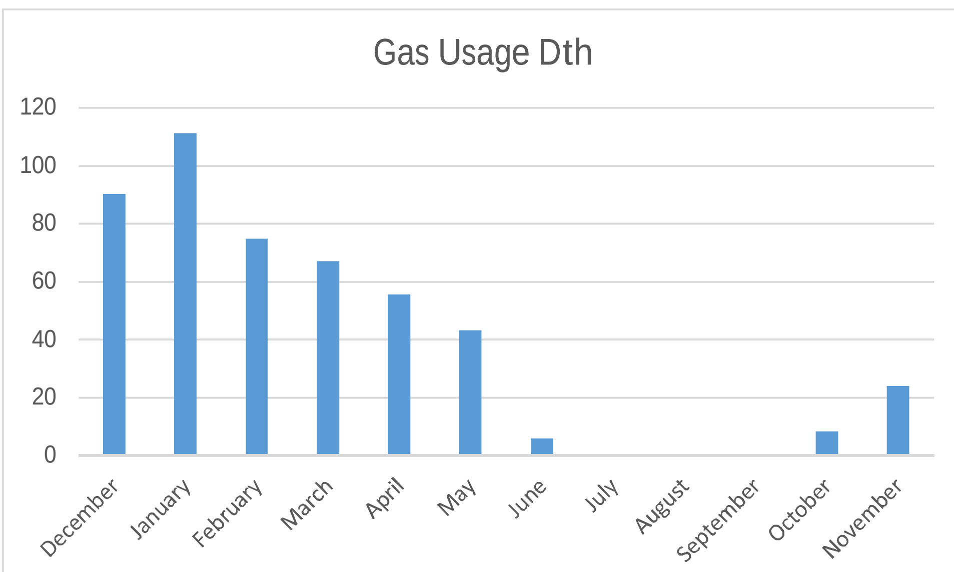
Billing Date	Elec Usage kWh	Elec Cost	Billing Days	kWh Ave/Day
12/24/2015	2,773	$ 434.76	33	84.0
1/26/2016	2,238	$ 353.97	33	67.8
2/23/2016	1,958	$ 311.78	28	69.9
3/25/2016	2,249	$ 355.54	31	72.5
4/26/2016	2,101	$ 333.28	32	65.7
5/26/2016	1,749	$ 280.34	30	58.3
6/27/2016	1,174	$ 193.87	30	39.1
7/27/2016	1,806	$ 290.70	32	56.4
8/26/2016	1,603	$ 260.35	30	53.4
9/27/2016	1,437	$ 235.18	32	44.9
10/26/2016	1,421	$ 232.76	29	49.0
11/28/2016	1,626	$ 263.83	29	56.1
12 mo avg	1845	$ 295.53	31	59
Total	22,135	$3,546.36	-	-



Energy Use by Month – Ground Floor Only

Natural Gas - Dekatherms, Dth (1 dekatherm = 10 therms = 1,000,000 BTU)

Billing Date	Gas Usage Dth	Gas Cost	Billing Days	Dth Ave/Day
12/24/2015	90.28	$ 511.78	33	2.74
1/26/2016	111.17	$ 577.12	33	3.37
2/23/2016	74.8	$ 386.16	28	2.67
3/25/2016	67.15	$ 333.64	32	2.10
4/26/2016	55.52	$ 276.49	32	1.74
5/26/2016	43.15	$ 221.40	30	1.44
6/27/2016	5.84	$ 38.66	30	0.45
7/27/2016	0.01	$ 0.01	32	0.00
8/26/2016	0.01	$ 0.01	30	0.00
9/27/2016	0.01	$ 0.01	32	0.00
10/26/2016	8.28	$ 77.26	33	0.25
11/28/2016	23.98	$ 178.54	29	0.83
12 mo avg	40.02	$ 216.76	$ 29.75	1.30
Total	480.2	$2,601.08	-	-



Ground Floor Energy Usage

Since natural gas is only used for space heating, the entire natural gas usage can be attributed to heating the ground floor of the building. The natural gas usage generally follows the expected consumption pattern expected for space heating in Cheyenne.

Cooling is not installed, so electricity usage can be attributed to service hot water, lighting, ventilation, computers, appliances, plug loads, and other miscellaneous uses. This electric use is fairly regular throughout the year, increasing a bit in winter when more lighting and perhaps space heaters might be used vs. summer with its longer days. Also, because the space is only partially and occasionally occupied, with an irregular schedule, it is difficult to assign consumption to any particular use patterns since it is variable.

Renewable Energy Systems

Because the primary source of energy used in in the operation of the building will be electricity for air and ground source heat pump systems, with natural gas playing only a back-up role (back-up heat, water heating), this building renovation represents an excellent opportunity to offset a significant amount of the energy the building will use via on-site solar photovoltaic (solar PV). The flat roof is large and unobstructed and can accommodate a very large system. A large PV system is currently part of the renovation equation, and we strongly support this as every kW of power generated by the PV system will directly offset a kW of energy used by the building systems. The more solar PV can be installed, the lower the ongoing operational energy costs will be.

Energy Type Allocation to End Uses

End Use	Primary	Secondary
Heating	Electricity	Gas
Cooling	Electricity	None
Hot Water	None	Gas

Summary

The renovation of the Hynds Building represents an outstanding opportunity to convert a largely vacant and inefficient but cherished and highly visible historic building in downtown Cheyenne into a what is likely to be one of the most energy efficient in the city, with one of the most modern and flexible HVAC systems in the region. By insulating the shell, rehabilitating or replacing the existing historic windows, installing highly-efficient air- and water-source heat pump technologies for space conditioning, as well as highly efficient domestic hot water and ventilation systems the building will be transformed. With the addition of enough solar PV it would be possible to bring net-energy usage down to zero. Even with a 40 or 50 kW system, net-energy usage will be significantly lower than other similar buildings, even modern ones, benefitting the tenants, occupants, building owners and the environment alike.