APPLICATION MUST BE COMPLETE TO BE CONSIDERED FOR JUDGING
(Required for Society-Level Competition)

(For ASHRAE Staff Use Only)

I. Identification (0 Points)

Name of building or project: Market 1

II. Category - Check one and indicate New, Existing, or Existing Building Commissioning (EBCx)

☐ Commercial Buildings	☐ New	■ Existing	☐ EBCx
Institutional Buildings:			
☐ Educational Facilities	☐ New	☐ Existing	☐ EBCx
☐ Other Institutional	☐ New	☐ Existing	☐ EBCx
☐ Health Care Facilities	☐ New	☐ Existing	☐ EBCx
☐ Industrial Facilities or Processes	☐ New	☐ Existing	☐ EBCx
☐ Public Assembly	☐ New	☐ Existing	☐ EBCx
☐ Residential (Single and Multi-Family)			

III. Project Description (0 Points)

1. Type of building or process: Office
2. Size – gross floor area of building (ft. sq. or m. sq.): 54,998 SF
3. Function of major areas (such as offices, retail, food services, laboratories, guest/patient rooms, laundry, operating rooms, warehouse/storage, computer rooms, parking, manufacturing, process, etc., or industrial process description:

   Office
4. Project study period: 03/2016 (Begin date (mm/yyyy)) to 03/2017 (End date (mm/yyyy))
5. Project Occupancy and Operation Period: 12/2014 (Begin date (mm/yyyy)) to 03/2017 (End date (mm/yyyy))
6. ASHRAE Standards referenced during design (this information will not be shared with the Judging Panel):

   ASHRAE 90.1-2010. ASHRAE 62.1-10. ASHRAE 55-2004

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1. **Name of Building or Project:** Market 1

2. **Entrant (ASHRAE member with significant role in project):**

   a. Name: Hersch, Mark, Charles
   (Last / First / Middle)

   Membership Number: 00319941

   Chapter: Iowa

   Region: VI

   b. Entrant's Design Firm/Company: MODUS

   c. Address (including country): Suite 300, 130 E. 3rd St.

   Des Moines (City) | Iowa (State) | 50309 (Zip) | USA (Country)

   d. Telephone: (O) 515.251-7280 e. Email: mhersch@modus-eng.com

   f. Entrant's Role in Project: HVAC and building automation design

   g. List the names of Design Team Members (A maximum of three may be listed below)

   1. Faryal Awan
   2. Holly Stevens
   3.

3. **Certification of entrant (0 Points) (If multiple entrants, all must be listed on this form)**

   I certify the information submitted is correct, and that this entry satisfies the requirements of the ASHRAE Technology Award competition.

   Typed Name: Mark Hersch Title: Senior Engineer

   Signature: Date: 3/20/2017

4. **Building Owner's release (0 Points)**

   I certify that I am the owner or the authorized representative of this project, and hereby grant permission to ASHRAE to use all the enclosed data and information in the judging and subsequent publicity of this project.

   Typed Name: Justin Doyle Title: Member

   Signature: Date: 3/20/2017

   (Signatures must be on form submitted to ASHRAE)

   Company: Market One LLC

   Address: 130 E 3rd Suite 400

   Des Moines (City) | IA (State) | 50309 (Zip) | USA (Country)

   Telephone: (O) 515-537-3728 Email: jdoyle@modus-eng.com

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5. **Engineer of record:** Required unless a written explanation is provided why the engineer of record will not grant his/her consent.

   I consent to the presentation of this project for consideration in the ASHRAE Technology Awards Program.

Typed Name: Justin Doyle, PE Title: Principal

Signature: _____ Date: 3/20/2017

(Signatures must be on form submitted to ASHRAE)

Company: MODUS

Address: Suite 300, 130 E. 3rd St.

Des Moines	Iowa	50309	USA
City	State	Zip	Country

Telephone: (O) 515.251-7280 Email: jdoyle@modus-eng.com

The topics below should be addressed on separate pages and formatted according to the requirements listed in the overview.

1. **Energy Efficiency (15 Points)**
2. **Indoor Air Quality (15 Points)**
3. **Innovation (15 Points)**
4. **Maintenance & Operation (15 Points)**
5. **Cost Effectiveness (15 Points)**
6. **Environmental Impact (15 Points)**
7. **Quality of Presentation (5 Points) (No response required)**

Return Completed Application to your Chapter Technology Transfer Committee Regional Vice-Chair.

For additional information, contact:

Candace Pettigrew
Chapter Programs Manager
678/539-1128
cpettigrew@ashrae.org

Project Description:

The project was the comprehensive renovation of an existing historical factory and warehouse building and an addition to that building. The reused building was 53,111 square feet with a partially subgrade lower level and three above grade levels. An 1,887-square foot penthouse was added as part of the renovation. The finished building is 54,998 square feet. The entire building is used as office space.

The building was constructed as an assembly facility and warehouse for Advance Thresher Company in 1888. The third level was added in 1918.

The building was renovated in 2013 to 2014 and has been occupied as a renovated building since December 2014.

The building is certified LEED Platinum by the USGBC using NC v2009 criteria.

The building is finishing its application to be designated a historical building and placed on the National Register of Historic Places by the State Historical Society of Iowa and the US National Park Service (NPS).

The building is in climate zone 5A. The applicable energy code is IECC 2009.

The reused building shell is a 12-inch thick brick mass wall with U-0.31 insulation value. The project added no insulation and no air barrier as the NPS forbade modification of the wall. The wall's mortar joints were tuck pointed but the shell is leaky.

The addition wall is U-0.031.

The reused building roof was improved to U-0.054. The addition roof is U-0.022.

The window openings are 16% of the wall area. Almost all windows are openable.

The reused building's north windows are wood, double hung sashes with clear, single thickness glass. These window frames and sashes were rebuilt but left in their 1918 configuration. The assembly insulation value is U-1.25 and SHGC is 0.82.

The NPS allowed the building's other three exposures to have modern glass if it maintained the historical appearance. The windows are wood, double hung sashes with clear, double pane, argon filled glass. The assembly insulation value is U-0.32 and SHGC is 0.48. The addition windows' assembly insulation value is U-0.28 and SHGC is 0.64.

Systems Description:

The building has a hybrid geothermal and air to air heat pump HVAC system.

The geothermal well field has fifteen 200-foot vertical wells. These were the most wells allowed by the site plan of the building.

The lower level is conditioned by water to air heat pumps connected to the well field. These units are 18.8 EER, 4.8 COP and have ECM fan motors.

The three above ground levels and the penthouse use three-pipe variable refrigerant flow (VRF) air to air heat pumps. The individual heat pumps may heat or cool and share energy with heat pumps on the same floor operating in the opposite mode. These units are 15.3 EER (95F), 4.4 COP (47F) and have ECM fan motors.

The constant volume dedicated outside air system (DOAS) uses geothermal to DX reversible heat pumps to heat or cool the ventilation air. These units are 18.9 EER and

4.0 COP. The supply and exhaust fans use VFDs for balancing. The outside air and exhaust air streams exchange total energy through a fixed membrane heat exchanger. The heat exchanger total summer efficiency is 53% and winter is 63%.

The interior lighting is 95% LED and 5% T5 fluorescent. All interior and exterior lighting are on lighting control systems. The interior lighting is manual on and vacancy off in the office and conference room spaces.

The photovoltaic system uses a rooftop installed array with a peak power output rating of 31 KW. Another 191 KW array covers the parking lot across the street from the building.

All the HVAC systems are controlled by a building wide direct digital control system.

The building's air side and water side systems were commissioned in compliance with LEED v2009 requirements for enhanced commissioning.

Energy Efficiency:

The building's projected energy use was modeled during design using Trace 700. The building was compared to a baseline building modeled using ASHRAE 90.1-2007 Appendix G. The proposed building modeled at an EUI of 55.1 KBTU / SF / YR, a 37.9% energy use savings compared to the baseline building modeled at 88.8 KBTU / SF / YR. The proposed building plus photovoltaic modeled a 61.1% energy use savings compared to baseline.

The building has an Energy Star score of 94 for the 12 months spanning March 2016 to February 2017. The Energy Star site EUI is 34.6 KBTU / SF / YR.

The building used 557,720 KWH (34.6 KBTU / SF) during the period. This energy was sourced by the electric utility and the photovoltaic system.

The building used 423,360 KWH utility energy during the period. This is a utility energy EUI of 26.3 KBTU / SF / YR.

The photovoltaic system produced 200,100 KWH (12.4 KBTU / SF) during the period. The photovoltaic was off line for the month of July 2016 as the inverters needed repair. The photovoltaic system offset 36% of the building's energy use.

The building used 134,360 KWH from the photovoltaic system and exported 65,740 KWH to the utility.

The focus of energy efficiency for the building included:

1. Installing almost all LED lighting with a lighting power density of 0.53 W / SF.
2. Installing a geothermal well field for part of the HVAC system. The geothermal systems are 17% of the installed HVAC capacity.
3. Precooling and preheating the building with the DOAS using 100% recirculation. This approach allows using the most efficient system for this task.
4. Using natural ventilation for the perimeter.
5. The DOAS uses geothermal to DX reversible heat pumps to heat or cool the ventilation air. The outside air and exhaust air streams exchange total energy through a fixed membrane heat exchanger.

6. The geothermal system pump has a VFD and modulates to maintain the supply to return temperature difference at set point.

Indoor Air Quality:

The applicable ventilation code is IMC 2012.

All four renovated levels have operable double hung windows and the areas within twenty-five, unobstructed feet of the perimeter use natural ventilation.

The building interior is mechanically ventilated by a dedicated outside air system (DOAS) that supplies 100% outside air and removes the same CFM through the rest rooms. The Ez for all areas is 0.8. The mechanically ventilated areas include offices, reception areas and lobbies which are ventilated at 0.075 CFM / SF and 6.25 CFM / person. The corridors are ventilated at 0.075 CFM / SF.

All outside air is processed through MERV 13 filters.

The design temperature goals were 75F DB / 50% RH in summer and 70F / 30% RH in winter. The metabolic rate was assumed to be 1.1 Met. The summer clothing insulation value was assumed 0.6 Clo. The winter clothing insulation was assumed 1.0 Clo.

The room temperature variation from set point is typically less than +/- 1.0F with user adjustable local set points between 70F and 75F. The thermostat adjustment range allows the occupants to select a comfortable environment predicted by ASHRAE 55.1-2004 figure 5.2.1.1 with dress varying from 0.5 to 1.0 Clo.

The building owner conducted a satisfaction survey in November 2016. The survey had a 50% return rate with 50 respondents. Office temperature elicited 78% satisfied, 8% neutral and 14% dissatisfied.

Twelve days of trend logging in the building's largest and most densely occupied office (third-floor open office, 6,220 SF) during March, 2017 indicated a CO2 peak under 770 PPM and room temperature in the 71F to 74F range. The office uses a combination of natural and mechanical ventilation. The peak CO2 compares favorably to the steady state 995 PPM expected for a code compliant office space (Lawrence, ASHRAE Journal, December 2008).

A March 17, 2017 survey of the third-floor offices and other working spaces indicated no air velocity above 40 FPM at occupants' desks and other working locations. The highest velocity was 30 FPM. This same survey measured temperature throughout the third-floor open office. The north perimeter was 72F to 73F. The rest of the room was 73F to 74F. The room's seven thermostats were variously set between 72F and 74F by the users close to their thermostat. The third-floor open office dewpoint temperature was 35F.

Innovation:

This building is one of the largest private photovoltaic electricity installations in Iowa. The installed capacity is 221 KW.

The four above ground levels use three-pipe VRF, allowing simultaneous heating and cooling on each floor with terminal units in opposite modes exchanging energy with each other.

The hybrid geothermal concept separates complete systems into either geothermal or air to air heat pumps instead of placing all systems on the well field and supplementing the well field with a fluid cooler and boiler. The benefit of placing as much building HVAC as possible on a geothermal well field is realized.

The DOAS operates at night and weekends during hot or cold weather to provide as much preheating or precooling as possible with the most efficient HVAC system, using the air to air heat pumps as backup. The DOAS configures to 100% return air recirculation when running during unoccupied hours.

The third-floor open office uses color changing LED lighting that follows the diurnal cycle to improve occupant mode and changes intensity as day lighting changes.

Operation and Maintenance:

The air to air heat pumps and the geothermal heat pumps allow very simple maintenance. Maintenance is filter changes, outside air unit coil cleaning, occasional checks of refrigerant charge and occasional checks of the geothermal brine chemistry.

The photovoltaic system is completely solid state with no moving parts, allowing very simple maintenance.

Cost Effectiveness:

The building was acquired and renovated for $13M or $236 / SF. This compares favorably with building a new class A office of the same size in the Des Moines down town that requires $262 / SF to acquire the land and construct the building.

The mechanical, plumbing and fire sprinkler systems cost $50 / SF and the electrical, lighting, cabled infrastructure, security and fire alarm systems cost $29 / SF. These costs compare to average Des Moines costs of $28 / SF and $18 / SF respectively.

Although the project as a whole is very cost effective, maintaining historical integrity results in expensive mechanical and electrical installations.

The VRF system was chosen for low first cost and high efficiency in heating and cooling modes.

Environmental Impact:

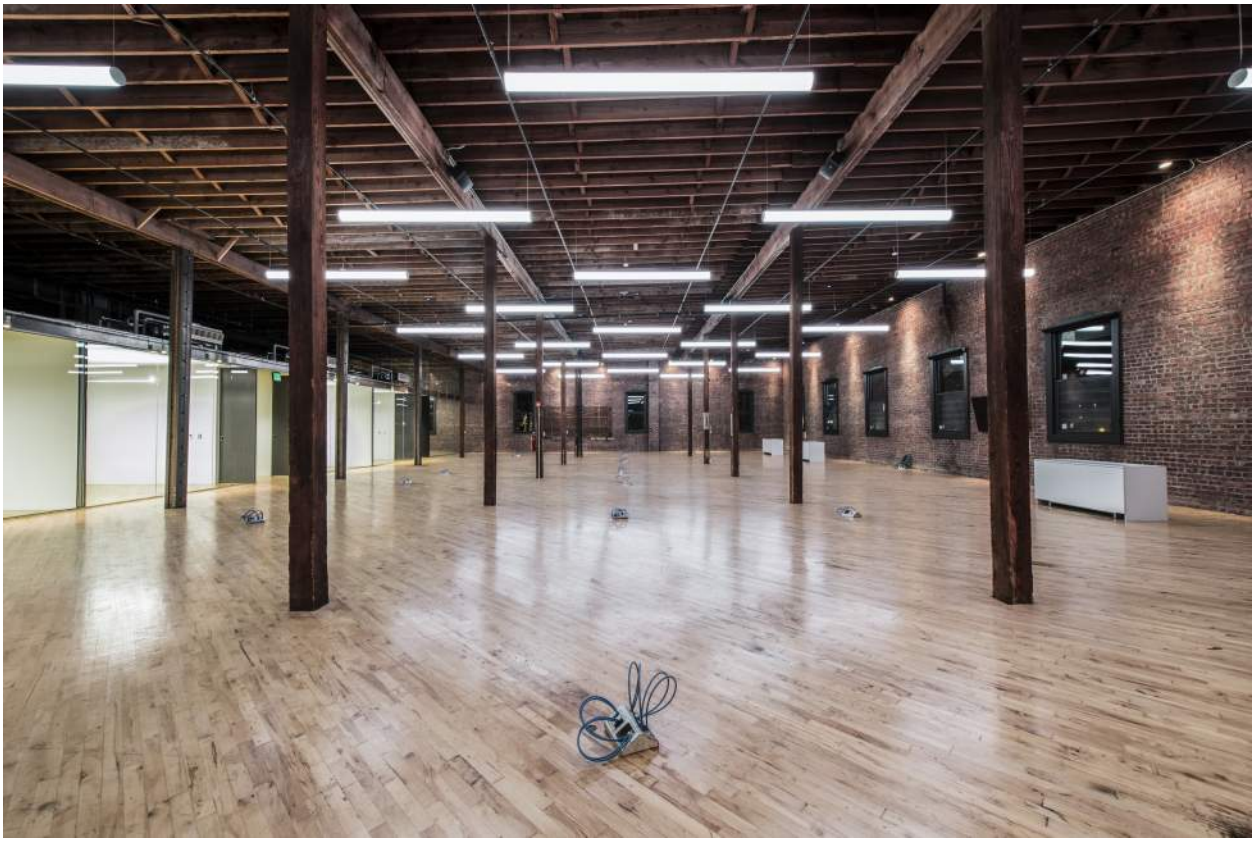
The VRF systems, water to air heat pumps and water to DX heat pumps use a zero-ozone depletion potential refrigerant, R-410A. No other system contains refrigerant.

The building's annual source CO2 production, with no photovoltaic consideration, is 279 metric Tons. A Mid-American Energy served median office building's (Energy Star score of 50) annual CO2 production is 575 metric Tons. The building shows a 50% reduction in CO2 compared to a median office building.

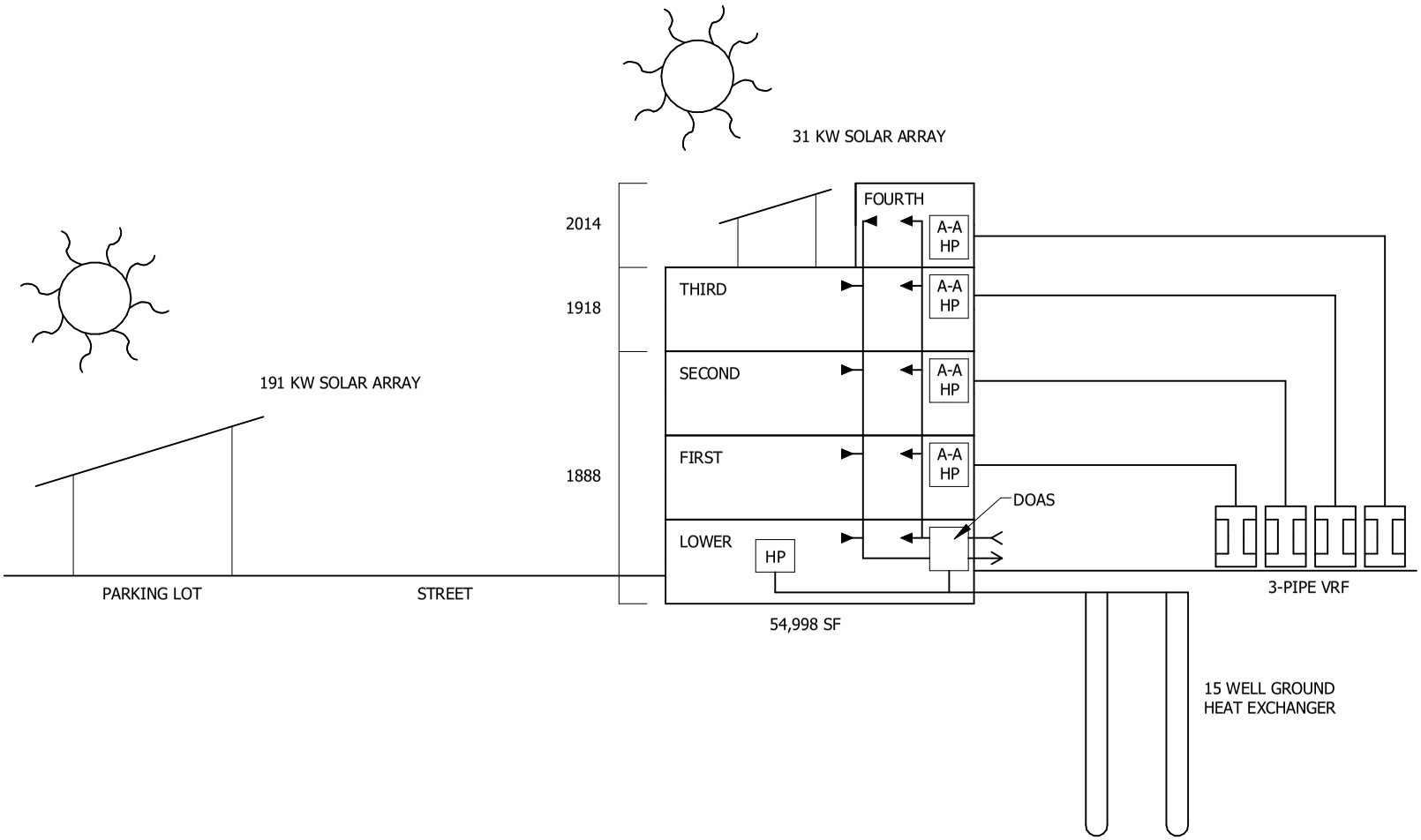
The photovoltaic system offset 36% of the building's electrical consumption between March 2016 to February 2017. This energy was either used by the building or exported to the utility. This caused an additional reduction of 100 metric Tons of source CO2.

The closed loop geothermal system and the air to air heat pumps do not need water replenishment so the HVAC system does not consume water.

Market One, East Exterior - Des Moines, IA



Market One, Third Floor Open Office - Des Moines, IA



MARKET 1
130 E. 3RD ST
DES MOINES, IA 50309