High Performance Sustainably Designed All Electric Home Case Study

Earth Day Update April 22, 2024

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The Nolan's live in a completely electrified, all renewable energy powered home integrated with many other sustainable design features. We moved in on May 15, 2020. This Case Study provides a comprehensive story and results including 42 months of energy use performance information.

Background

We sold our long-time home in Plymouth, Mn in January of 2019. We had located an emerging new housing development called the Villas of Inspiration in Bayport, MN. The is in the St. Croix National Scenic River area with many parks and conservation areas. It was an undeveloped treed site surrounded by a larger Inspiration Development and 127 acres of conservation reserve prairie protected by the Inspiration Stewardship Foundation.

Guidelines for Inspiration Parkway Nolan Home Design April 2019

Address Bayport Environmental Community Goals and Policies and determine community incentives:

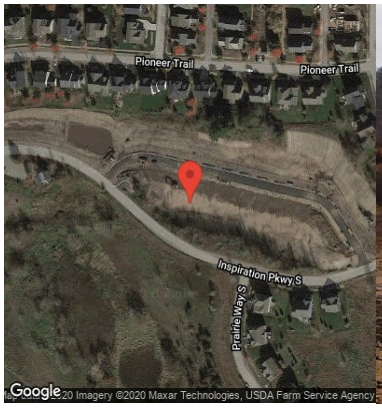
- Utilize existing regs or formulate new performance standards and design requirements to protect natural features.
- Integrate new development and resort to natural features where feasible.
- Provide incentives for energy, water sustainability improvements for existing and new development.
- Allow for implementation for alternative energy power generation in appropriate locations.
- Promote energy efficient, low impact lighting for all land uses.
- Protect existing and future trees.

Initial Goals - Integrate Sustainable Design Features

- Passive solar – high levels of south glazing and roof design to maximize solar gain.
- Potential active solar panels or other generation technology.
- Beyond code insulated and low air exchange, with air-to-air heat pumps.
- Energy efficient windows, doors, appliances, and water efficient toilets.
- High amount of thermal mass for passive solar and radiant heat from high efficiency wood stove insert.
- Native landscaping.
- High quality natural materials (e.g., no vinyl), recovered wood and stone.
- Integrate Universal Design Principles.

General Design and Footprint

- Two stories with double master bedrooms. One master and 3rd guest bedroom and office second floor.
- Slab on grade foundation.
- Two car garage.
- Small footprint 5,764 square feet lot area 62ft length 40ft width.
- Bordering 127-acre Minnesota Land Trust Conservation Easement reserve prairie.
- Villas of Inspiration 24-unit, 7.5 acres site, surrounded by three out lots of prairie area and stormwater flows to wetland.




Design Build Implementation and Features

- Construction Timeline: design process April 12 – May 24, 2019, and construction period November 2019 – May 2020
- High efficiency building envelop insulation - slab on grade.
- Hardy Board siding for durability and sustainability attributes.
- High performance Marvin windows throughout the home and insulated exterior doors.
- Passive solar design measures with extensive daylighting. Interior shades and Solar Shade Skylight.

- LED lighting throughout home.
- Best available air heat pump and hot water Heating-Ventilating-Air Conditioning system including heat exchanger and Smart Thermostat controls.
- Best available high efficiency wood stove fireplace insert capable of heating entire home and backup heating.
- Energy star appliances kitchen and laundry. EPA WaterSense toilets.

Select Materials Use

- Exterior cedar beams and corbels. Exterior landscape rock repurposed.
- Gemstone Innovative performance-based concrete containing recycled fly ash. Includes a Sustainability Assessment of Concrete Materials and Products.
- Tamko Heritage Roof Shingles: 40-year warranty, prorated for 40 years.
- Scrap wood from installation wood materials was repurposed and used as firewood to general backup heat, eliminating construction waste.
- All granite remnant countertops kitchen, dining area, and bathroom counters.
- Cabinetry- locally made. Custom popular or knotty alder cabinets throughout home. Flat panel mission style in-set doors with soft closed doors and drawers throughout home.

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Framing

- T&G ¾" plywood sub-floor on main floor and upper floor
- 2"x 6" Exterior wall construction and OSB walls
- Exterior walls fully wrapped with Tyvek, Tyvek tape and Tyvek window flex wrap
- Roof sheathing with 1/2" OSB
- Engineered trusses for upper floor, garage bonus trusses and roof trusses
- 9', 1 O', 11' main level ceiling heights per plan, 8' 1 1/8" upper-level ceilings per design plan.

Insulation
R-19 fiberglass insulation on all exterior 2x6 walls with vapor barrier.
R-15 for foundation walls; R-10 foam on exterior of foundation walls.
R-50 blown-in cellulose insulation for house attic, batt ceiling R-38 in areas too tight to blow with vapor barrier.
Packed fiberglass around all window and door openings. Sprayed foam in upper floor rim.

Exterior

- Shingles: Tamko Heritage 40 year warranty, prorated for 40 years, proration depreciates 2 % per year, after 40 years, never drops below 20% proration, covers manufacture defects, doesn't include natural weathering/age/hail/storm damage.
- Siding (body)-all four sides: LP lap siding, staggered shake, board & baton per plan.
- Natural Stone (allowance $10.00/sq. ft.) front piers and wall around front door. Stone capped with 2 ½ " Indiana limestone per plan.

James Hardy Board Siding Performance & Durability | James Hardie
James Hardie fiber cement siding products are durable, lower-maintenance, and an alternative to wood and vinyl. Hardie® fiber cement siding and trim are specifically formulated to better resist damage from predators—moisture, freezing temperature, humidity, pests and fire—that pose threats to engineered wood products. It resists the impact of hail and windblown debris and is designed to perform in extreme heat and cold. James Hardie tests its products to better withstand worst-case scenarios: hurricanes, UV rays, snowstorms, and more. Fiber cement products are Engineered for Climate®. Home insurance is generally less for engineered siding.

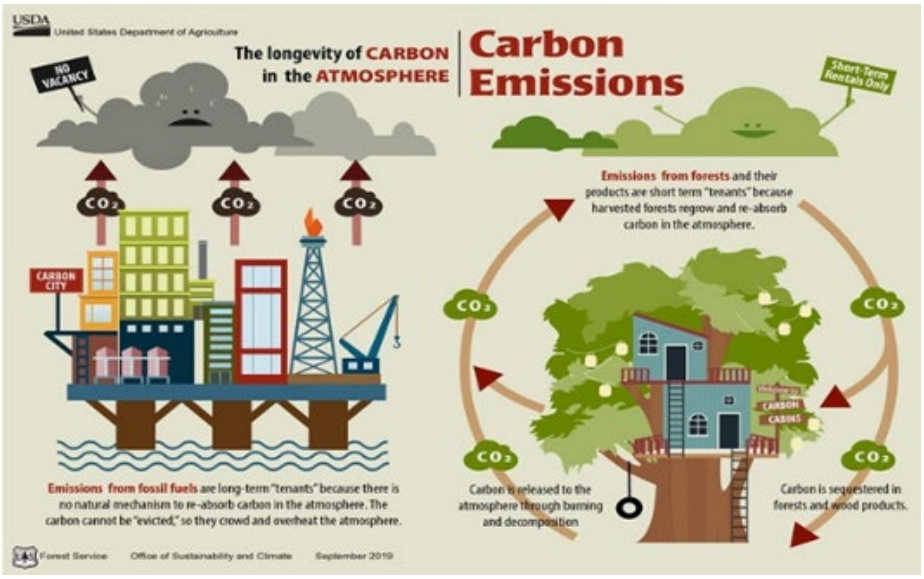
Cemstone Cement
Cemstone offers a variety of sustainable concrete options and practices. Portland-limestone cement (PLC) is a blended cement with a higher limestone content, which results in a product that works the same, measures the same, and performs the same, but with a reduction in carbon footprint of 10% on average. Sustainability encompasses many aspects designed to improve construction practices, including more efficient use of natural resources, better thermal performance of structures, and reduced environmental impacts, with a focus on embodied carbon. Like all building materials, portland cement has an environmental footprint, and it is often described in terms of greenhouse gas equivalents. Cement is made by grinding clinker—the main energy intensive ingredient—to a fine powder.

Cemstone has participated in the National Ready Mixed Concrete Associations (NRMCA) industry-wide Environmental Product Declaration (EPD) Program. An Environmental Product Declaration (EPD) is defined by International Organization for Standardization (ISO) 14025 as a Type III declaration that "quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function. Cemstone has developed EPDs for 20 of their manufacturing facilities in accordance with strict international standards. Supplementary Cementing Materials conserve valuable resources by increasing the use of fly ash (an industrial byproduct) in place of cement, material is re-used while the carbon dioxide emissions from cement manufacturing are reduced.

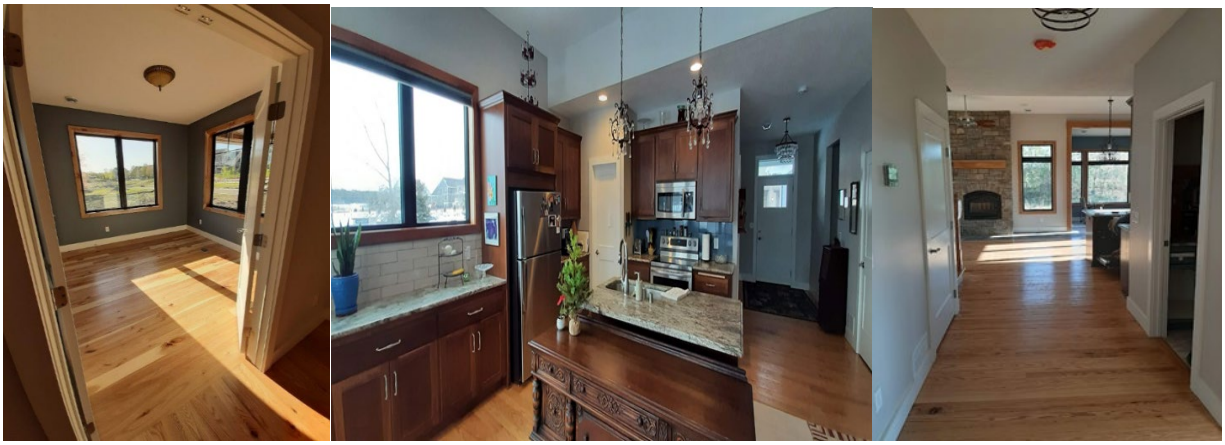
Natural Wood Used Throughout

Natural hardwoods – red oak, cherry, bitternut hickory – were sustainably harvested from family farm – milled into flooring, window casing and jams, and a fireplace mantel. Timothy Nolan managed all the lumbering, milling, and drying to deliver materials to the site during construction. Logging residuals and construction clean scraps were dried and used as firewood delivering high efficiency wood heat to the home. In addition, leftover wood construction materials

As trees grow, they feed on carbon dioxide in the atmosphere and trap it in the form of wood as long as the wood exists, the carbon is captured and not released back into the atmosphere. This makes wood not just carbon neutral, but carbon negative, as a building material.



Wood products have low embodied carbon compared to other building materials. This means they generate fewer greenhouse gas emissions. Additionally, wood continues to store carbon absorbed by trees during their growth, resulting in a lower overall carbon impact[1]. With its natural properties wood can contribute to creating healthier indoor environments. By promoting better air quality and comfort, making it an excellent choice for sustainable building design. It is renewable and can be recycled or repurposed.



Quadra Fire EPA Certified Wood Fireplace

Pioneer II model - 74,900 BTU per hour peak output, heating capacity up to 2,600 ft2, 10 hour burn time, 77 percent efficiency, 3.3 grams an hour emissions rate.

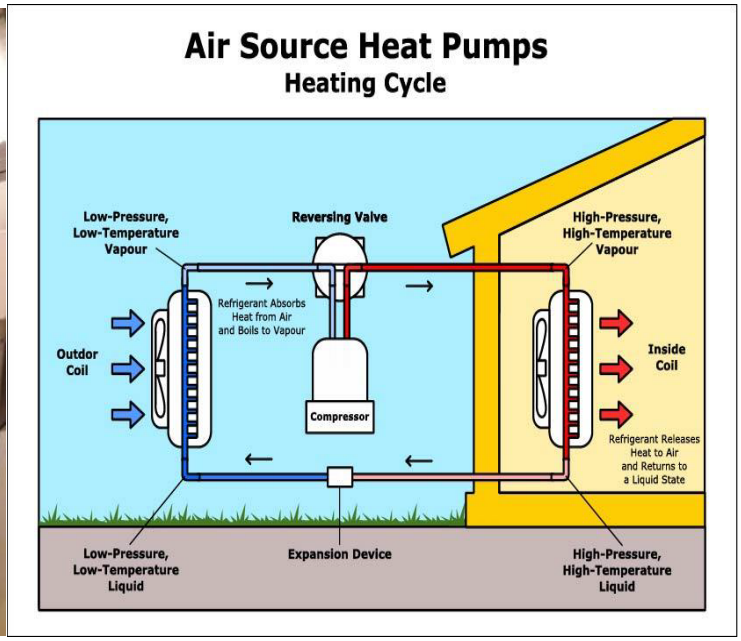
Heating Ventilation and Airconditioning

Carrier Day and Night 18 SEER heat pump/air conditioner, variable speed inverter driven heat pump. Capacity 36,000 BTUs 3 tons. Non-ozone depleting R-410A refrigerent. VH8 - Heat Pump | Heating and Cooling | Day & Night® (dayandnightcomfort.com) Upgrade to 400 Amp Service (due to furnace requirement-200 amp service in contract) cost $1000. Got an Xcel Energy Rebate for HVAC Heat Pump $550

Electric Heat Pump Water Heater - Rheem 692104 Proph 50-T2-RH350-DCB Rheem 692104 Proph 50-T2-RH350-DCB - Search (bing.com)
50 Gallon 4200 BTU Electric Heat Pump Water Heater 3.50 EF W/Integrated Wi-Fi Controller Serial # 301-1208, Unit Cost $1,595 and got an Xcel Energy $400 Water Heater Rebate.

- Energy Savings vs. Minimum Standards: 65% to electric resistance.
- Expected Energy Savings Over Average Equipment Lifetime: Up to $900 over 10 years.
- Major Advantages: Most efficient electric fuel option.
- Sustainable: reduces carbon footprint with 75% reduction in energy use
- Note 400 amp circuit added $1,000. Water Heater cost was $600-1500 more expensive than conventional eligible for $300 federal rebate.

Uniform Energy Factor UEF 3.55 (a measure of its energy efficiency, with higher numbers denoting more efficient units. Energy Star certified conventional gas and electric water heaters have UEF ratings between .65 and .95 – or 65 to 95 cents on the dollar – while heat pump water heaters have much higher UEF ratings between 2.75 and 3.5.



Windows

Marvin Integrity windows Low E, double pane glass, good U-values with built-in grids. U-Factor .29 measures total heat flow through a window or door from room air to outside air. Lower numbers indicate greater insulating capabilities. It's a particularly important measure for climates with colder winters. This U-factor is more conducive to passive solar gain. Energy Efficient Windows and Doors | Marvin Certified Products Directory (nfrc.org) R-Value is the resistance a material has to heat flow. Higher numbers indicate greater insulating capabilities. Marvin is an industry leader in offering a wide selection of products that meet these rigorous criteria.

Solar Heat Gain Coefficient (SHGC) measures how much radiant heat enters your home. The lower the number, the less heat a window lets in. Visible Transmittance is the amount of visible light transferred through a window. Low E coatings can reject solar heat gain without significant reduction to visible light passing through the glass.

Cellular Shades

Cellular shades provide superior insulation and energy efficiency and are the most energy-efficient shade style available. Solar shades block UV rays and reduce heat and glare to provide light control. Vinyl blinds do not save energy and field studies have shown that cellular shades outperform traditional vinyl blinds in terms of energy efficiency.

Hunter Douglas Energy Efficient Cellular Shades used in this home on all windows are treatments that improve the home's energy efficiency by providing insulation, controlling solar heat gain, and by using natural light to reduce the use of electric light (called daylighting), which saves energy. Here's a look at each—and how they help create your comfort zone.

Integrating Passive Solar Design

Passive solar design is a technique that uses the sun's energy for the heating and cooling of living spaces by exposure to the sun. When sunlight strikes a building, the building materials can reflect, transmit, or absorb solar radiation. In addition, the heat produced by the sun causes air movement that can be predictable in designed spaces. Passive solar design involves the purposeful construction of "windows, walls, and floors… to collect, store, reflect, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer". Passive Solar Design – Sustainability (williams.edu)

Providing Insulation—Winter/Cool Climates In winter, or if you live in a cool climate, window treatments help insulate the window, preventing heat from escaping and keeping a room warmer. Open your window treatments during the day so that free solar heat from direct sunlight will warm your home. On cloudy winter days, close your window treatments to add an insulating layer to your house that will keep warm air in. At night, close your window treatments to add that insulating layer.

Controlling Solar Heat Gain—Summer/Warm Climates
During the day, close your window treatments to prevent the sun's harsh rays from heating up a room, keeping it cooler (so your A/C doesn't have to work as hard). At night, keep your window treatments closed to keep the cool air in.

Solar Skylight-upper level-Velux skylight 22" x 44" with room darkening solar shade, fixed glass, shade is battery/solar powered. *Included a federal rebate.*

Using Daylighting
Natural light illuminating a room can make it more inviting and may even boost your mood at the same time. You can maximize natural light with window treatments that draw it into a room, reducing the need for electric light, which reduces energy use.

Appliances

WaterSense toilets - home has 2.5 bathrooms each with a White Pro Flo PF 1500WH/PF6 11 2WH toilet. This is 20 percent less water than the current federal standard of 1.6 gallons per flush. The average family can reduce water used for toilets by 20 to 60 percent per year.
LG French Door Energy Star Refrigerator – non GHG refrigerant.
True Convection Electric Range NE59J7650WS/AA Samsung 30"
Microwave ME16K3000AS/AA Samsung 1.6 CF 300 CFM
Built in Fully Integrated Energy Star Rated Dishwasher MDB7979SHZ Maytag 24" 5 Wash Cycles; 249 Kwh a year; NSF Certified to sanitize cycle options that eliminate 99.9% of all household germs.
Samsung Microwave ME16K3000AS 1.6 cu ft LED display and Eco Mode
Frigidare Top Load Washer (water saving) and Electric Dryer FFRE4120SW 27”

Home Energy Source

The home utilized one hundred percent Xcel Energy Renewable Connect Flex program (formerly Windsource) that enables customers to get more or all their energy from renewable resources, as it is one of the nation's largest voluntary renewable energy programs. This costs and additional .041kWh. On an all-electric home, Xcel offers a reduced winter (Oct-April) rate energy charge at .059kWh, while summer rate (May-Sept) energy charge is .10kWh. The home switched to solar photovoltaics April 2024.

Solar Photovoltaics

The Nolan’s installed solar panel in April 2024 that will produce 113 percent of their yearly electricity, replacing Renewable Connect Flex. Through net metering (see definition below), Xcel will have to buy back excess kWhs. Size: 10.080kW DC STC - Annual Production: 12,730kWh - Annual Solar Access: 96% - Offset: 113%. Solar system is 24 panels of Rec Alpha Pure-R SERIES.

Any billing cycle where solar is produced more than the home’s energy consumption will be paid out as follows: $0.12328/kWh (Oct-May) and $0.13222/kWh (Jun-Sep). The rate is slightly higher in Summer. In addition, Xcel’s Solar Rewards program will pay homeowners directly. Solar Rewards is paid out every January. The amount is $0.03/kWh that the system produced in total the previous year. It is paid via check. This program lasts 10 years. Owners will be able to see how much their system produced on the production meter that is installed.

1. Engineering Site Visit: a technician sent to the home to collect the necessary project details.
2. System Design: A design team will create a detailed image of the system.
3. Incentive, Interconnection and Permit Filing: All the necessary paperwork to receive the maximum rebate amount, the utility connection forms, and electrical and building permits.
4. Financing: Determine financing and payment arrangements.

5. Secure Product and Install: Order and secure the equipment for the system, determine a date at a date for delivery, and schedule the installation.
6. Inspections: Schedule the system electrical and building inspection. The electrical inspector will need to sign off and approve the new system before proceeding to the next stage!
7. Utility Interconnection: The system is turned on.
8. Close-out Appointment: The Salesperson will meet with the homeowner and answer post-installation questions, explain the monitoring system, and deliver a personalized care package.
9. Service Team: A service team will address any questions that may arise after completion.

Net Metering and Compensation
Generally, if a customer produces more electricity than it uses, a utility will compensate or credit the customer for their excess generation depending on the option the customer elects to receive in the contract they signed with the utility. Utilities keep the rates updated in a rate book.
The amount a customer is paid for the electricity they do not use is found in their utility's tariff (often called the compensation rate). The compensation rate depends on several factors:

1. The size of the customer's system;
2. The specific costs and retail rates of their utility (updated annually); and,
3. Whether the customer is served by a cooperative, municipal, or public utility.

Net Metering & Compensation / Public Utilities Commission (mn.gov)
Solar*Rewards® is your opportunity to have solar for your home or business. It's an incentivized program, so annual payments are made to the owner of the solar system in exchange for Renewable Energy Credits (RECs) for the energy produced by the solar system. All solar customers receive net energy metering benefits. When the system produces more solar energy than is needed, the extra energy is added to our grid, and you may receive a credit on your monthly bill.

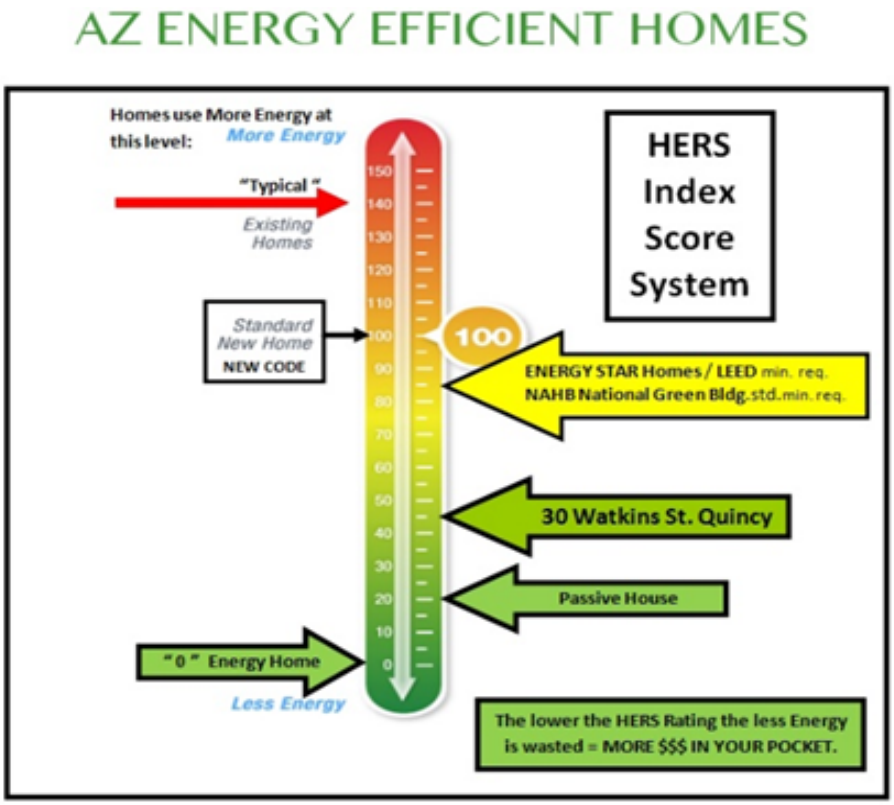
High Performance Sustainable Design

Sustainable building refers to both a structure and to processes that are environmentally responsible and resource-efficient throughout a building's life-cycle: from siting to design, construction, operation, maintenance, renovation, and demolition. According to the National Institute of Building Sciences, high performance buildings integrate and optimize all major high-performing building attributes, including energy efficiency, durability, life-cycle performance, and occupant productivity.

Modern sustainable building methods, like Passive building, LEED® (Leadership in Energy and Environmental Design) and Net Zero building can help you minimize environmental impact and maximize energy efficiency. ENERGY STAR also offers a "Most Efficient" list, a distinction that recognizes products that deliver superior efficiency through cutting-edge technologies and innovations.

Some of the most effective ways to incorporate green building practices into a custom home. How To Create A Sustainable Custom Home Design | G.J. Gardner Homes (gjgardner.com)

The Efficient New Home Construction program provides incentives for builders to build homes that exceed local energy code and baseline requirements for energy efficiency by at least 10%. Homes must be evaluated by a RESNET accredited Home Energy Rating System (HERS) Rater. The HERS Raters help builders achieve energy savings by providing plan review analysis and onsite verification throughout the construction process. The Nolan home HERS rating is 53.



Lessons Learned

- Focus on developing a good design plan complete with guidelines to drive the process.
- Do your research on features, methods, and technologies to achieve a high-performance home. Apply the best available tools like the HERS rating system.
- Be hands on in pushing the developer and contractors beyond the status quo. Spend time on site overseeing construction to ensure quality and minimize mistakes.
- Identify federal, state, and utility incentives and assistance that support innovation.
- Understand heat pump systems must be sized correcty based accurate energy load calculations and correct regional temperatures zones. Mn need cold climate heat pumps.

Locally Sourced Natural Landscaping Rock Surrounded by Prairie Grass

Resource Links

Sustainably Designed Homes Are the Future (sustainablestillwatermn.org)
Plan your next electrification project today (rewiringamerica.org)
electrify-households-scolly (rewiring-america.netlify.app)
Design Load Calculation Tools | Northeast Energy Efficiency Partnerships (neep.org)
This new tool will help you plan your home… | Canary Media
A beginner's guide to the different types of heat pumps | Canary Media
Electrify Everything in Your Home — Rewiring America
Homepage - Attainable Home
Preferred Contractor Network Homeowner Resources — Minnesota ASHP Collaborative (mnashp.org)
The Inflation Reduction Act: what you need to know | Clean Energy Resource Teams
Home Energy Rebates / Minnesota Department of Commerce - Energy (mn.gov)
Residential Electrical Panel Upgrades / Minnesota Department of Commerce - Energy (mn.gov)
Residential Heat Pump Rebate Program / Minnesota Department of Commerce - Energy (mn.gov)
EPA ENERGY STAR website

Addendum One – Heating, Ventilation, and Airconditioning

Carrier Day and Night 18 SEER heat pump/air conditioner, variable speed inverter driven heat pump. Capacity 36,000 BTUs 3 tons. Non-ozone depleting R-410A refrigerent. VH8 - Heat Pump | Heating and Cooling | Day & Night® (dayandnightcomfort.com) Upgrade to 400 Amp Service (due to furnace requirement-200 amp service in contract) cost $1000. Got an Xcel Energy Rebate for HVAC Heat Pump $550

- Electric furnace additional circuits for resistive heat cost $400.
- Carrier Day and Night electric backup air handler.
- Honeywell heat exchanger.
- HRV and April Air humidifier.

Features and Benefits

- Quiet performance (as low as 56 decibels)*
- 5 stages of variable-speed compressor operation, providing our best temperature and summer humidity control
- Variable-speed fan works with compressor for best levels of quiet, efficient operation
- Dual fuel capable with a compatible gas furnace and thermostat for energy-saving heating
- Durably built with tight wire grille and protective corner posts to withstand bad weather and debris
- Designed for corrosion resistance and lasting performance
- Wi-Fi® enabled remote access with the Ion™ System Control[1]
- 10-Year No Hassle Replacement™ Limited Warranty±
- 10-Year Parts Limited Warranty+

Specifications

- High-efficiency variable-speed rotary compressor
- High-efficiency variable-speed fan motor
- Advanced electronic control quietly switches between heating, cooling and defrost modes
- System protecting high pressure switch, low pressure transducer and filter drier
- Durable, protective tight wire grille panels allow easy coil cleaning; corner posts for extra strength and style
- High-gloss, baked-on powder coat finish over galvanized steel
- Sound-reducing features: aerodynamic variable-speed fan, soft mounted compressor, high performance acoustic-absorbing compressor blanket, and Quiet Shift defrost
- Compatible control: Ion™ System Control installed as part of a complete communicating system for full function and efficiency capability, Wi-Fi® remote access convenience, and intelligent diagnostics
- Electronic Expansion Valve for efficient heating control
- Non-ozone depleting R-410A refrigerant
- Cooling capacity: 2–5 tons

Two zone deluxe thermostat Ion™ System Control Thermostat SYST0101CW Ion™ System Control Thermostat SYST0101CW - Search (bing.com) features include temperature, fan, and

humidity control for upper and lower zones. Scheduling controls and weather and energy tracking, service information and utility demand event response for utility demand or price response programs. Wi-Fi® enabled for remote access and control.

- Capable of controlling temperatures and fan speeds in up to eight zones
- Real-time energy use tracking
- Local weather 5-day forecast
- Humidity control for enhanced comfort
- Dual fuel system management capable
- Auto changeover between heating and cooling
- Four levels of "constant ON" fan speeds
- 7-day programming with temperature control throughout the day and week (wake, away, home, sleep)
- Advanced smart setback for optimal energy savings during "away" and ramp up periods
- One-button Touch-N-Go® quick-settings-change feature
- Simple vacation programming controls

Ineligible for an Xcel rebate because contractor selected Smart Thermostat was not on their eligible list.

Addendum Two Solar Photovoltaics

Project Info

Overview | Segment A | Segment B | Segment C

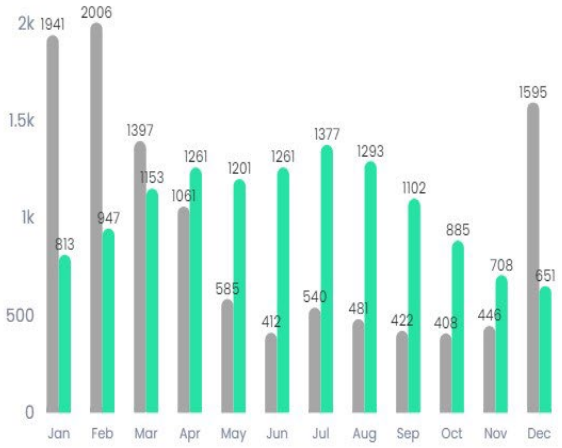
Overview

Segment	Modules	Size (DC STC)	Production	ASA	Consumption	PV Offset	Roof Area	Roof Coverage
All total	24	10.08 kW	12,651 kWh	95%	11294 kWh	112%	877 ft²	59.11%

Nearest weather station: 726584, ST PAUL DOWNTOWN AP, MN (13.75 mi)

Average Monthly Solar Access

Monthly Consumption and Production (kWh)



Segments

Segment	Modules	Size (DC STC)	Production	ASA	Azimuth	Tilt	Roof Area	Roof Coverage
Segment A	18 (420W)	7.56 kW	9,554 kWh	98%	193°	36°	643 ft²	60.44%
Segment B	3 (420W)	1.26 kW	1,580 kWh	96%	193°	35°	110 ft²	59.05%
Segment C	3 (420W)	1.26 kW	1,517 kWh	92%	192°	35°	124 ft²	52.3%

Solar Metering

Addendum Three Home Performance

RMI

FACT SHEET

All-Electric Buildings: Key to Achieving Minnesota's Climate Goals

To reach Minnesota's goal of net zero carbon emissions by 2050, we must stop burning fossil fuels in buildings. Heat pumps are a readily available and effective solution for reducing building emissions today.

Buildings are a major source of carbon emissions

46% of Minnesota's energy-related carbon emissions come from buildings.[1] Of this, more than two fifths stem from burning fossil fuels (gas, oil, and propane) for heating, cooking, hot water, and other uses. Despite progress decarbonizing other sectors, these **emissions have only decreased by 11% in Minnesota since 2016**.[1] The good news is that we have better technology at our fingertips and can convert these fuel-burning appliances to heat pumps and other efficient, electric systems.

"Why are we transitioning off gas?"

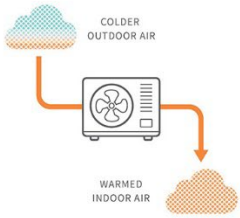
Methane gas (a.k.a. natural gas) served as a "bridge fuel" in the transition away from dirtier forms of energy like coal. That need has changed as Minnesota has increasingly adopted renewable energy, reducing electric grid emissions by 35% since 2010.[1] It's time to take the next step in the energy transition by harnessing this cleaner grid to power our buildings.

91% *of Minnesota homes burn fuels on-site for cooking, heat, or hot water.*[2]

67% *of commercial buildings in Minnesota's region burn fuels on-site.*[3]

Heat pumps are two efficient appliances in one

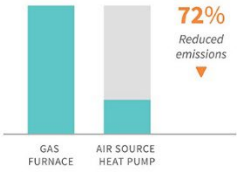
Heat pumps are so efficient because **they *move* heat rather than *make* heat**. In winter a heat pump gathers warmth from the air or ground (even in sub-zero temperatures) and moves it indoors. That flow is reversed to cool buildings in summer by moving heat outdoors. Heat pumps can replace both a furnace and an air conditioner. Plus, they can be used in water heaters, clothes dryers, and other appliances.

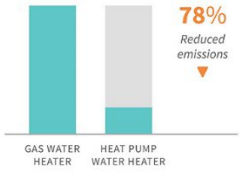


All-electric buildings reduce carbon emissions

Replacing fossil fuel appliances with electric heat pumps dramatically reduces carbon emissions from buildings in Minnesota. This is because **heat pumps are 2 to 4 times more efficient than gas appliances**. The carbon savings are even more significant when replacing oil and propane systems, and will only improve as Minnesota's electricity grid continues to get cleaner.

Lifetime gas and electric appliance emissions in Minnesota[4]





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Energy Code Compliance Certificate	Residential Contractor:	License#:
	Landucci Homes, Inc	BC626262
	Dwelling Address:	Date Certificate Posted:
	683 inspiration Place, Bayport	

Insulation			Building Envelope Air Tightness	
Location	R-Value	Type	Blower Door Results	1133
Ceiling Flat	50*	fiberglass	Air Changes @ 50Pa	2.74
Ceiling Vaulted	50*	fiberglass	Total Duct Leakage Test	
Below Slab	10*	rigid foam	Conditioned Volume in Cubic Feet	24819
Foundation Wall	NA		Conditioned Floor Area in Square Feet	2510
Rim/Band Joists	27	spray foam		
Above Grade Wall	20	fiberglass	Radon Control System	
Floors over unconditioned area	30*	fiberglass, rigid	Type	passive
Ductwork	8	fiberglass	Location	attic

Mechanical Systems			
Appliances	Heating System	Cooling System	Domestic Water Heating
Fuel Type	Electric	Electric	Electric
Manufacturer	ICP	ICP	Rheem
Model Number	FCM4X48**	CVH836GKA**	PROPH50 T2 RH350
Rating or Size	34200 BTU	3 ton	50 gal
Efficiency	10 HSPF	17.5 SEER	3.69 EF

Windows			Ventilation			
	U-Factor	SH GC	Type	ERV	Calculated Heat Loss	
			Location	mech room	Calculated Heat Gain	
Average	.29	.29	Balanced CFM	65*	Calculated Cooling Load	
			High and Low	130, 65*		
*Verified by Other						

TEN WORLDWIDE
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