

SUSTAINABLE CONSTRUCTION IN INDIAN COUNTRY

EXPANDING AFFORDABILITY WITH MODULAR
MULTIFAMILY INFILL HOUSING



Native American Youth and Family Center

“The housing shortage in Portland’s Native community is a direct result of a lack of access to culturally relevant housing opportunities. If the opportunities exist to move from homeless to housed, from renter to homeowner, we believe in our community’s ability to jump on board.”

-Matt Morton, Executive Director, NAYA



Problem

The metropolitan area of Portland, Oregon, has experienced a population boom. This has increased demand and cost of rental and homeownership housing, creating a tight housing market for lower income minority groups, especially Native Americans. Locations available for new construction are often infill sites that demand innovative solutions to lower construction costs and create affordable housing.

Solution

The Native American Youth and Family Center (NAYA) designed and had built a modular multifamily prototype project to demonstrate the speed of construction, superior quality, affordability, and green qualities of modular housing.

Community Snapshot

Location: Portland metropolitan area, Oregon

Location type: Urban

Native American Population: 23,010 (Multnomah County per 2008 American Community Survey)

Climate: Daytime high average of 80 °F in July and August. Average low of 36-38 °F from December to February. The greatest precipitation—nearly 7 in—falls in December. (Köppen classification *Csb*)

Critical Sustainable Technologies and Strategies

- Modular units with decreased waste
- Highly insulated and air-tight units
- ENERGY STAR compact appliances
- Mini-split heat pumps (in studio units only)
- Infill, transit-oriented development
- Minimized conventional turf and drought-resistant plantings
- High-efficiency water fixtures
- Onsite stormwater management
- Recycled materials in deck and landings
- ENERGY STAR bathroom fans with automatic timer

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Funding

Funders	Amount
Portland Housing Bureau tax increment financing, 2010, 2011	\$922,398 \$398,749
Permanent loan One Pacific Coast Bank	\$320,000
Meyer Memorial Fund	\$200,000
Total	\$1,841,147

U.S. Department of Housing and Urban Development (HUD) awarded nine project-based Housing Choice vouchers.

The Oregon Housing and Community Services Predevelopment Fund and the Native American Youth and Family Center both made loans to the project, which were repaid and are not part of the final costing.

Map



Summary

Kah San Chako Haws (East House in Chinook) is the first multistory, multifamily modular building in Portland. For this prototype, the time from design to move-in was 14 months—a savings of 4 months over the typical site-built construction. Constructed for low-income families and individuals with unstable housing situations, each of the three buildings is assembled from three modular units. The studios measure 375 square feet, the one-bedroom units 675 square feet, and the two-bedroom units 835 square feet. While a single prototype is not going to solve the problem of affordability or fully realize the potential of the modular model for producing more affordable housing, NAYA’s development team wanted to demonstrate the cost and time savings that could be achieved in affordable housing while providing a unit superior to and greener than most conventional, affordable housing. They have been very pleased with the results—as have the neighbors and the residents.



Architect’s rendering of Kah San Chako Haws

Here are some of the technologies and their effect on sustainability.

Sustainable Technologies	What Is It?	Effect
Modular construction	Modular housing is built in a factory using assembly-line techniques. It is built to the International Building Code, the same code as conventional-built wood-frame construction. It can incorporate a range of designs (Modular Home Builders Association).	Housing is constructed in the factory with less waste of material, greater worker safety, and less damage from exposure to the elements. The emphasis on precision leads to high quality, energy efficiency, and tight construction that is less expensive and quicker to complete.
Transit-oriented development	Transit-oriented development (TOD) is compact, mixed-use development located near transit facilities that promotes sustainable communities by providing people of all ages and incomes with improved access to transportation, shopping, social services, employment, and housing choices; decreased commutes and transportation costs; and reduced negative impacts of automobile travel on the environment (HUD Community Planning and Development).	In addition to the benefits listed in the definition, a study in Evanston, Illinois, showed decreased vacancy rates, increased retail sales, and stable-to-increasing housing prices in the neighborhood of the TOD.

Here are some of the technologies and their effect on sustainability (continued).

<p>Spray foam</p>	<p>Spray foam insulation is used in walls, ceilings, crawlspaces, and other parts of buildings. It seals heat inside during cold weather and does not allow water to penetrate inside.</p>	<p>Spray foam insulation stops air and moisture infiltration, making homes more comfortable, healthy, energy efficient, and stable.</p>
<p>High-density infill development</p>	<p>Infill development is defined as new construction on vacant or underutilized sites within an established neighborhood or district (Strategic Economics). For places with land shortages, this may be some of the only land available for development.</p>	<p>TOD and infill can take advantage of existing, underutilized infrastructure systems, increasing the efficiency and reducing the costs of providing municipal services to new development. It sometimes triggers additional investment need due to past deterioration or to increase services for increased population.</p>
<p>Mini-split heat pump</p>	<p>Ductless, air-source heat pumps are also called mini-split heat pumps. They operate on the same principle as traditional heat pumps, using electricity to move heat between outdoor and indoor air by compressing and expanding a refrigerant, although without a duct system.</p>	<p>Because they deliver heated or cooled air directly to the room, ductless heat pumps avoid efficiency loss associated with ductwork. According to the Department of Energy (DOE), duct loss can account for more than 30% of energy consumption for space conditioning. Ductless heat pumps were used only in the studio units.</p>
<p>High-efficiency water fixtures</p>	<p>Low-flow aerators, such as those recommended under the Environmental Protection Agency's (EPA's) WaterSense program, use specialized airflow regulators to mix water and air to reduce water flow while increasing pressure. Low-flow showerheads also significantly reduce water flow.</p>	<p>Replacing old, inefficient faucets and aerators with WaterSense-labeled models can save the average family 700 gallons of water per year, equal to the amount of water needed to take 40 showers. Because these water savings reduce demands on water heaters, households also will save enough energy to run a hairdryer 10 minutes a day for a year. (WaterSense is an EPA partnership program.)</p>
<p>ENERGY STAR ventilation fans</p>	<p>ENERGY STAR appliances are independently certified through a program of the EPA and DOE. ENERGY STAR-certified ventilation fans that include lighting use 70% less energy on average than standard models. Based on their fan type and airflow, they must meet maximum allowable sound levels (in sones), minimum efficacy levels (in cubic feet of airflow per minute per watt [cfm/W]), and a percentage of 0.1 in. water gauge static pressure rated airflow at 0.25 in. w.g. static pressure.</p>	<p>ENERGY STAR products save money and protect the environment. ENERGY STAR certified ventilation fans:</p> <ul style="list-style-type: none"> • Provide better efficiency and comfort with less noise. (Noisy fans are less likely to be used.) • Feature high performance motors and improved blade design, providing better performance and longer life.

Creating Opportunities in the Housing Continuum

The metropolitan area of Portland, Oregon, is home to the ninth largest Native American community in the United States, with 380 tribes represented (*Making the Invisible Visible*). In 1974, parents and volunteers who wanted children to learn about and have a place to express their Native American identities through culture, arts, and sports established the Native American Youth and Family Center (NAYA). Although NAYA's mission is to serve self-identified Native Americans, NAYA operates from a relational world view that seeks to serve the whole person by considering all elements in a person's life.



As a 501(c)3 organization, NAYA is not a tribal organization; anyone who feels comfortable within its service model is welcome. Executive Director Matt Morton explained, "By following this approach to serving Native Americans, we have actually found an approach that is more inclusive."

Forty years later, NAYA is a nonprofit organization with 120 full-time employees, offering a range of wraparound style services (including a high school). Morton said that NAYA is "seeking to move families through the whole housing continuum" —from shelter to rental housing to homeownership. A few years ago, NAYA took on the administration of 44 housing units with property management contracted out. Other housing services include a weatherization programs for homeowners and homebuyer education.

Despite their efforts, Deputy Director Rey España and others realized that the rising cost of housing in the rapidly growing Portland area was reducing affordable opportunities. Between September 2012 and 2013, the average new construction sale price was \$316,400 (HUD Policy Development and Research). Toward the end of 2013, the average rent was \$829 for a one-bedroom and \$952 for a two-bedroom unit. In response, NAYA decided to "challenge ourselves," said Morton, by developing affordable housing. In addition to inspiring other developers, NAYA saw this project as a way to start playing a bigger role in expanding housing opportunities and serving its community. "The more control we have over property, the more we can be strategic in bringing in and retaining residents," Morton said. NAYA assembled a community development team, including outside partners, rather than creating an internal full-service development department that would require NAYA to conduct development activities at a pace the organization was not yet prepared to take on.

Project partners included Emmons Modular, Guardian Real Estate Services, modular manufacturer Blazer Industries, and Walsh Construction. Guardian had extensive experience in affordable housing development and was familiar with the ins and outs of state and city compliance and funding. The partnership built capacity in NAYA but worked both ways, said Morton. "We help build capacity in our partners to respond more effectively to the community's needs." Earth Advantage is providing Leadership in Energy & Environmental Design (LEED®) certification services. The project anticipates a LEED® gold certification.

Thinking Inside the Box

Modular housing is a type of prefabricated or manufactured housing. Unlike mobile and manufactured homes, modular housing is built to International Building Code standards.

NAYA's modular units were constructed in a factory based on designs from Emmons Modular. Kah San Chako Haws was constructed of plywood, 2x4s, drywall, etc. Modular units can also be steel- or concrete-framed.

Almost everything that can be done on site is installed in the factory: walls/ceilings/floors, mechanical, electrical, plumbing, appliances, and interior finishes. Because construction takes place inside, materials are not subjected to long periods of environmental exposure—prime time for mold development. Other benefits include significantly reduced construction time, decreased construction waste, purchasing economy of scale (depending on the number of modules constructed at once), higher accuracy, and safer working conditions. In the factory, most construction takes place on ergonomic flat surfaces, with workers working at 3-ft-high tables during panel construction.



Modular construction in the factory



Crane siting modules

Emmons Modular's Stuart Emmons spent a lot of time at the factory overseeing the project and helping to streamline the construction process. He said that this design and construction process requires a shift in thinking for developers, architects, engineers, and contractors. Conventional onsite construction typically begins with designs that are about 85 to 90 percent complete and involves weekly meetings and numerous on-the-job adjustments (leading to change orders and increased budgets). Modular plans, on the other hand, are nearly 100 percent complete, with precise measurements and detailed order lists from the outset. The materials are cut and fit together like a puzzle. If units will be stacked, the units

must be designed and fit with almost perfect precision to sit one on top of another. The design still can accommodate some change, but a modular design is not likely to run over budget due to change orders.

The completed unit is loaded on a tractor trailer and moved to the site. Because of the issues related to moving oversized loads, most U.S. modular factories prefer to ship within a 500-mile radius of the manufacturing plant.

The Modular Learning Curve

As with any less common construction method, the prototype faced some procedural hurdles, although Kah San Chako Haws faced fewer because of the team's research on modular construction beforehand. The state of Oregon was familiar with modular and inspected the units in the factory. The city of Portland, on the other hand, was new to a project in which 85 percent of the inspections took place in the factory. The insurance company and bank expressed concerns about collateralization; that is, how they would get their money back in the event of a problem: Who had financial responsibility for the unit when in the factory since it was not yet connected to the site? What if the unit fell off the truck during transportation to the Holgate Street site? In fact, drawing on past modular projects, the team made the case that risk was actually reduced due to reduced length of construction and resolved concerns. Having resolved these issues will speed the process for future modular affordable housing projects.

During the 6 weeks that the units were under construction in the factory, the onsite team prepared the site: pouring the foundation and installing site utilities. The construction team, although experienced in onsite conventional construction, encountered a learning curve that other modular housing project teams have reported. Modular units do not have the same "tolerance" as site-built construction, which has greater room for improvisation when items do not fit exactly. Team members at the construction site double-checked dimensions for the seismic connection plates (a required earthquake protection). At the factory, however, they discovered that the rigid insulation installed had locked rotating connection plates at the bottom of the wall and that several plates were not lined up with the site measurements. The fix took about 5 minutes but saved about 3 days of work and a hefty change order by taking place at the factory instead of after delivery.



Inspecting the module at the factory

NAYA planned the development with HUD project-based Housing Choice vouchers (also known as Section 8) from the Home Forward, Portland's housing authority. España developed the tenant selection process so that it met Section 8 requirements. NAYA interviewed, screened, and income-validated prospective tenants, and España sent out acceptance letters. At this point, he learned that Home Forward wanted to conduct its own screening. In the end, only one of the nine selected tenants did not pass the second set of screenings but, as a new housing developer, NAYA was anxious to put forward its best foot with the tenants and wished that the process could have been coordinated more smoothly.

Supporting the Community of Residents and the Neighborhood

Kah San Chako Haws is located in the Lents neighborhood of Portland, within blocks of a TriMet Metropolitan Area Express (MAX) rail service station running downtown. España first met with the Lents neighborhood association 2 years before the project was developed. Community leaders were primarily concerned with neighborhood disruption during the construction process. España also found some unexpected supporters, clients of NAYA who lived in the area. The neighborhood turned out to have a larger Native American population than many knew.



A crane hoists modules into place.

When the crane—at a cost of \$2000–\$6,000 a day—eventually rolled into the location to hoist the modules into place, the neighbors were drawn in. The siting of the modules took 3 days. When neighbors saw how quick and quiet modular housing construction was, the neighborhood association told España that he was welcome to develop in their neighborhood whenever he liked.

Superior Quality

España is proud that the units can combine a pared-down design—what would a person who was homeless or in an unstable living situation need to be independent?—with quality materials and the construction advantages in modular housing. A 2007 study at the Massachusetts Institute of Technology found that “A modular structure has a certain inherent strength superiority to a traditional site-built home due to the fact that each module is a self-supporting and independent structure.” These units have a Home Energy Rating System (HERS) Index score of 70, which indicates that the units are rated as 30 percent more energy efficient than a standard new home. This is all the more important because residents at Kah San Chako Haws pay their own utilities.



Interior of model two-bedroom unit

For some of the tenants, the adjustment to living in a space all their own has had its challenges. España said, for example, that some residents have not used the dishwasher—which is smaller than standard size—because of fear of the cost. A full, energy-efficient dishwasher will actually use less water and energy than handwashing dishes. Residents are not required to participate in NAYA services, but many of the residents already have a relationship with NAYA. España emphasizes that services are available, and that NAYA has a proven ability to engage Native American and other clients by providing wraparound services through a relational model. Morton agrees, “Connecting our community with a service is what we do best.” Further,

he believes that it is the access to services that will make these and other housing units part of a housing continuum for some residents rather than a stopping point. “Houses are hollow boxes if services are not attached. People don't move on.”

Project Summary

LOCATION: Portland, Oregon

DESIGN/PLAN TEAM: NAYA, Emmons Modular, Guardian Real Estate Services, Blazer Industries, Walsh Construction

TIMELINE: Design began in September 2011. Residents occupied units in April 2013.

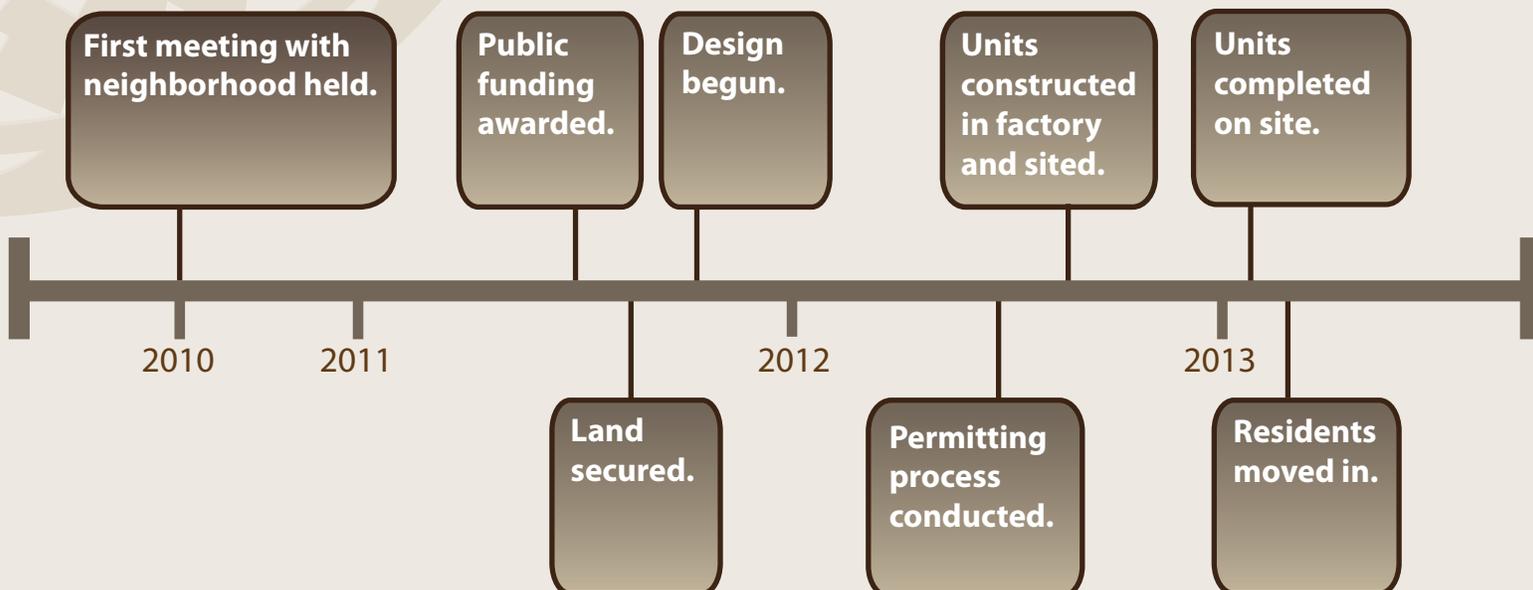
PROJECT TYPE: Nine-unit multifamily buildings with studio, one- and two-bedroom units

Project Key Features

- Affordability
- Americans with Disabilities Act-compliant
- In-unit laundry
- High-density development
- Double-pane vinyl windows
- Vinyl flooring

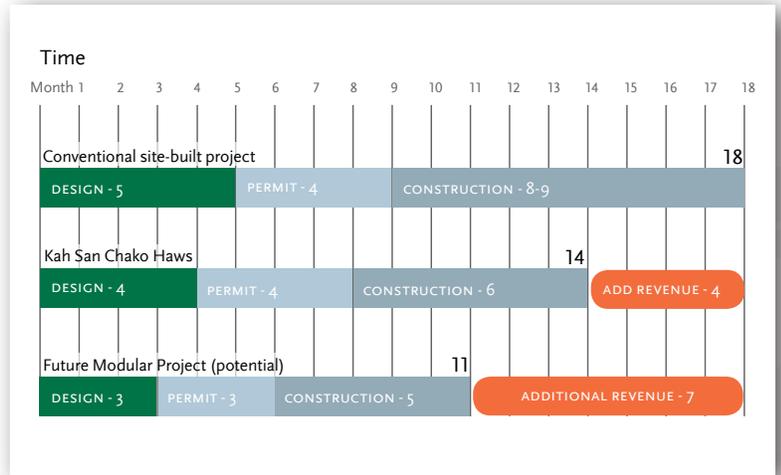
Key Sustainable Elements

- Modular units with decreased construction waste
- TOD
- Energy-efficient water distribution and low-flow fixtures
- Onsite stormwater management
- Recycled materials in deck and landings
- Mini-split heat pumps (in studio units only)
- ENERGY STAR bathroom fans with automatic timer
- ENERGY STAR smaller sized appliances
- Minimized conventional turf and drought-resistant plantings
- Highly insulated and air-tight units
- Low volatile organic compound finishes
- LEED® gold certification

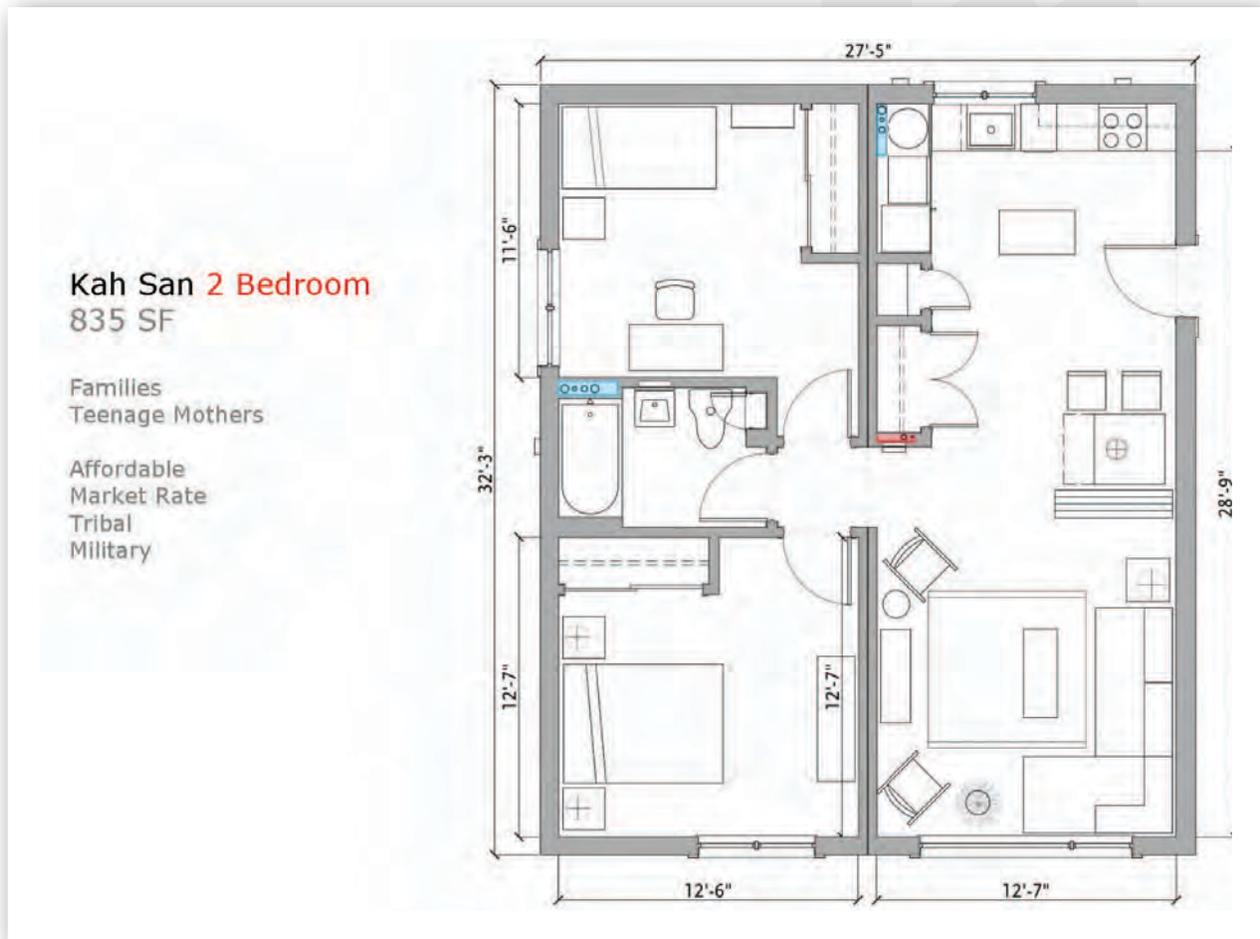


Best Practices

With Kah San Chako Haws, NAYA and its development team hope to encourage additional innovative thinking in affordable housing to increase the quantity of affordable housing. The 14-month design-to-move-in time was conservative for modular construction, but it met the team’s goals and shaved 4 months off site-built housing construction. After numerous project analysis meetings, however, the design team is confident that with an easily replicable design and increased use of features that reduce any onsite work (roof, siding, pipes in the hall) an 11-month timeline is within reach. Kah San Chako Haws was a successful prototype that proved the potential for reduced cost through reduced time for modular affordable housing.



Because it is constructed in a factory using precise plans, modular housing inherently impacts the environment less. The construction technique produces less waste, and leftover materials are often kept for use in other projects. The precision required to fit the units together leads to a unit with lower air penetration, saving on heating costs.



The units came in at a cost of \$204,572 a unit, but the team anticipates additional cost savings for subsequent projects. Whereas siding is often installed in the factory, it was completed on site for this project as part of a workforce development effort. Installation took 2 1/2 months rather than the 2 weeks it would have taken with a professional onsite team. As projects scale up to 40 or more at a time, Emmons Modular's Stuart Emmons said, "The lower cost will come from replication and streamlining."

But beyond construction, design, and materials, team members believe that other parts of the housing development pipeline—financing and regulatory—are also ripe for streamlining.

Next Steps

NAYA plans to continue to successfully develop housing in collaboration with a team. Its next housing project will feature housing for families who adopt a foster child, housing for elders, and a school serving infants through kindergarteners. Intergenerational activities will be a requirement. The housing will not be modular to fit in better with the surrounding neighborhood's bungalow-style housing. NAYA anticipates developing additional modular units in the future. Other modular projects focused on affordability took off in 2013–2014 in Los Angeles, Renton (WA), Manhattan, and Brooklyn.

For more information:

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How To Get Started

To learn more about the energy-efficiency strategies and construction techniques highlighted above, check out these resources.

NAYA Housing Services:

<http://nayapdx.org/services/housing/>

Emmons Modular:

www.emmonsmodular.com

Modular Building Institute:

<http://www.modular.org/>

EPA ENERGY STAR Program:

<http://www.energystar.gov/>

DOE, on selecting windows for energy efficiency:

<http://windows.lbl.gov/pub/selectingwindows/window.pdf>

Affordable Housing Finance, December 2013:

<http://mydigimag.rrd.com/publication/frame.php?i=181749&p=&pn=&ver=html5>

Center for Transit-Oriented Development:

<http://www.ctod.org/>

Communicating the Benefits of TOD: The City of Evanston's Transit-Oriented Redevelopment and the Hudson Bergen Light Rail Transit System:

<http://www.ctod.org/pdfs/2006CommunicatingBenefitsTOD.pdf>

This best practice case study is one in a series that examines how Native American and Alaska Native communities have incorporated sustainable technologies and strategies into their housing development.

The Sustainable Construction in Indian Country initiative was created to support and increase sustainable construction practices in Native American communities. It is administered through the U.S. Department of Housing and Urban Development's Office of Policy Development and Research in partnership with the Office of Native American Programs.

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