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Community Biomass Handbook

Volume 3: How Wood Energy is Revitalizing Rural Alaska

Dan Bihn

Forest Service

Pacific Northwest Research Station

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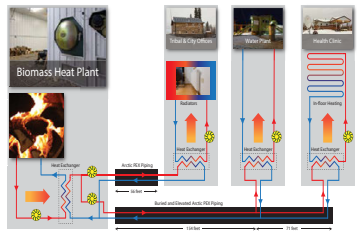
About This Book



This book is intended to help people better understand how wood energy is helping to revitalize rural Alaskan communities by reducing energy costs, creating jobs, and helping to educate the next generation.

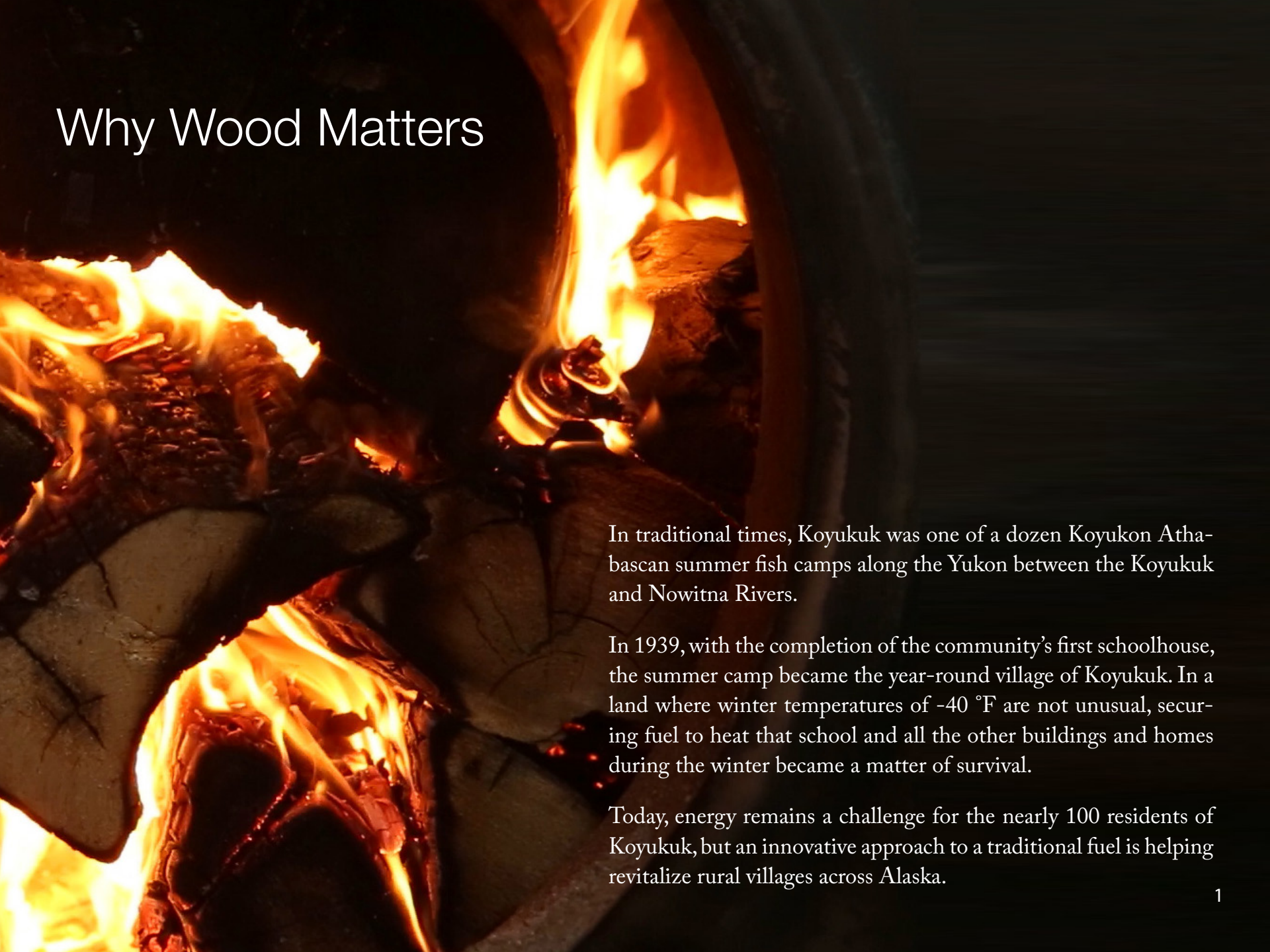
The village of Koyukuk shows how modern wood energy systems can meet the challenges of remote rural Alaska. To fully succeed, however, these systems need to become part of the fabric of community life.

Remote rural villages have become part of a much broader Internet-enabled community. Alaskans have always been pioneers in using the latest telecommunication technology for telemedicine and distance learning.

Today, communities are starting to monitor their wood energy systems over the internet and share that data with others—improving reliability, reducing the cost of maintenance, and opening up exciting educational opportunities.

Contents

Why Wood Matters



In traditional times, Koyukuk was one of a dozen Koyukon Athabascan summer fish camps along the Yukon between the Koyukuk and Nowitna Rivers.

In 1939, with the completion of the community's first schoolhouse, the summer camp became the year-round village of Koyukuk. In a land where winter temperatures of -40 °F are not unusual, securing fuel to heat that school and all the other buildings and homes during the winter became a matter of survival.

Today, energy remains a challenge for the nearly 100 residents of Koyukuk, but an innovative approach to a traditional fuel is helping revitalize rural villages across Alaska.

A typical site in Koyukuk. Logs cut in 4-foot lengths sized to fit trailers and sleds. The logs will dry out for a year, and be cut and split into firewood when needed.

Many homes use both wood and heating oil. Heating oil stoves are easy to manage and can be automatically controlled by a thermostat when no one is at home. But that convenience comes at a price.

Most Homes in Koyukuk Heat With Wood

Most of Koyukuk's sixty or so houses have a neatly stacked pile of firewood outside. Over a year, that wood provides about half the energy needed to heat a typical home. Heating oil provides most of the rest.

For families, firewood takes work, but not a lot of money. Like meat and fish, firewood is a typical part of a subsistence lifestyle, not the cash economy. Wood is harvested from local forests or "caught" as it floats down the Yukon River after the river ice breaks up in the spring (spring breakup). And that's the way it's been for a long time.

Heating oil is convenient and can keep a house warm for days when no one is home. For homes with running water, this can prevent pipes from freezing. For the elderly and infirm who are unable to manage firewood, heating oil often makes it possible to live independently.

But heating oil isn't cheap. It is delivered to Koyukuk once a year by barge during the four-month summer when the river is ice-free. The fuel barge travels 300 miles down the Yukon River from the port of Nenana, 55 miles west of Fairbanks. Nenana is on both the highway and rail systems, giving it affordable access to Alaska's oil refineries and seaports. But the barge trip from Nenana to Koyukuk more than doubles the cost of the fuel (in 2016, heating oil sold for $6.50 per gallon).

Koyukuk's library heats almost exclusively with heating oil. A wood stove could heat this small building, but someone would need to stoke it in the middle of the night so that the library could be used first thing in the morning.

The Ella B. Vernetti School is heated with both heating oil and recovered heat from the adjacent power plant. It is difficult to imagine heating this 13,896 sq. ft. building with conventional wood stoves.

Most Community Buildings Use Heating Oil

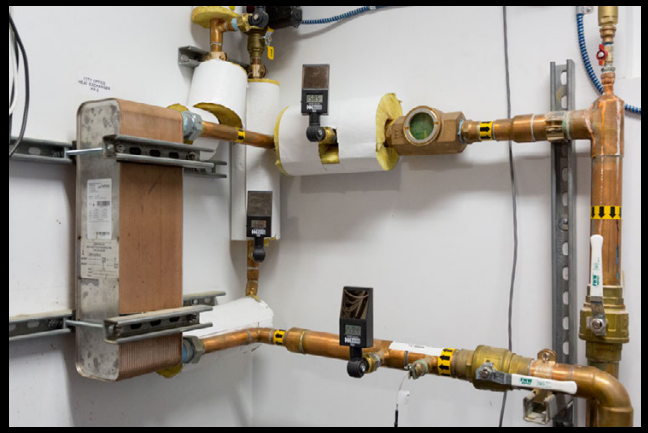
Until recently, most community buildings have heated almost exclusively with expensive heating oil—a significant part of the cost of education, health, and administrative services. So why heat with expensive heating oil instead of local wood?

Managing wood stoves is complicated. Someone has to get the wood, split it, haul it into the building. Then someone has to frequently stoke and clean the stove. This can take staff away from their primary tasks, and managing part-time staff for this sort of work can be challenging. If the stove isn't stoked late at night, the building can be too cold to use in the morning, and plumbing can freeze causing serious damage.

Managing heating oil is simple. Oil boilers and stoves are easy to use. They are controlled by thermostats, so in the morning—even after a long weekend—buildings are warm and ready to use. Fuel is fed from the outdoor tank. These tanks can easily be refilled once or twice a month without bothering the people inside.

Fuel costs are often paid for by outside agencies. The higher cost of heating oil is often considered an unavoidable part of running a school, clinic, or administration building. External agencies and organizations often pay this cost, so using less heating oil seldom means more money for the community.

Koyukuk's biomass heating plant is a separate building located near most of the village's community buildings. The messy part of heating with wood stays here.



This is all it takes to connect a building's existing heating system to the biomass heating plant: this small heat exchanger (left) and two heat distribution pipes (right).

Modern Wood Boiler Systems

In early 2015, Koyukuk completed its first wood heating plant, which delivers heat to three community buildings: the administration building, the new health clinic, and the water plant (including the washeteria).

The building's temperature is automatically controlled by existing thermostats or the building control system. If the wood boiler system stops working or runs out of wood, the building's conventional heating system automatically takes over.

By following two key principles, heating community buildings with wood can be more convenient, reliable, and affordable than heating oil systems.

Put the wood boiler in a separate, workshop-like space designed to handle firewood. Wood is hauled into this boiler room where is it stored and then manually fed into the wood boiler by the boiler operator. The wood boiler heats water (typically between 150 and 180 ˚F) that is then circulated to the community buildings. The messy part of wood energy all happens here (upper left).

Deliver heat to each building by circulating hot water from the wood boiler through a pair of insulated pipes—one pipe for the heated water entering the building and one pipe for the water returning to the boiler. Heat from the circulating hot water is transferred to the building's existing heating system through a small metal device called a heat exchanger (lower left).

The job of running and feeding the boiler is steady job—a good match for people with school-age children. The boiler may only need to be stoked a few times a week in warmer weather, but a few times a day in the coldest weather.

Collecting, cutting, and splitting wood for the biomass heating plant take time and effort. But this work can be done throughout the year when schedules permit, fitting nicely into subsistence lifestyles.

Wood Boilers Create Jobs

It takes work to harvest and split wood, and it takes work to operate and fuel Koyukuk's wood boiler. That work means paying jobs.

Flexible subsistence-lifestyle-compatible jobs. Gathering and processing firewood can be done throughout the year whenever it is convenient for the people doing this work. Gathering wood is a normal part of life for most families. Now these families can earn extra income without changing their schedules.

Steady family-friendly jobs. The biomass boiler need to be operated and fed. In spring and fall when heating needs are modest, a few times a week can be enough. On the coldest days of winter, the system can be fed a few times a day. The more it is fed, the less heating oil is used.

Paying for those jobs. Wood boiler systems significantly reduce the amount of heating oil brought into the community. Part of that savings helps reduces the cost of running water plants, clinics, and administration buildings. Part of that savings goes into local jobs.

These jobs help keep families in the community. That helps keeps the school in the village. Everyone wins.

With help from NASA, the world's first satellite-based distance learning was pioneered along the Yukon in the 1970s. Today, Internet-based learning is an integral part of the Yukon-Koyukuk School District's curriculum.

As with teens everywhere, nothing beats hanging out with your friends and watching YouTube videos. The Internet has redefined "remote village." Videos of snowmachine races and wrecks were popular this night.

A Truly Global Village

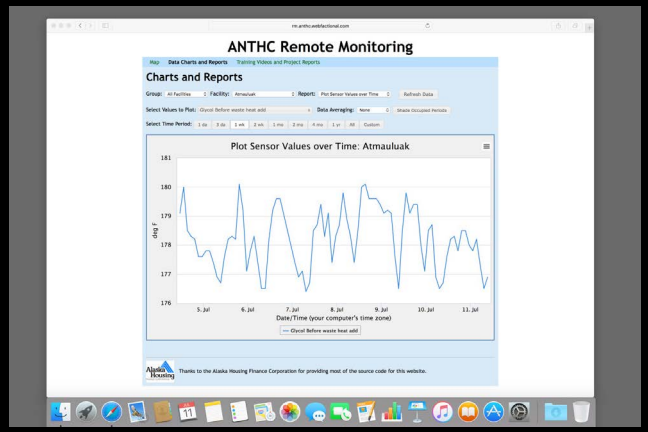
The Internet has become part of the fabric of life here in Koyukuk. Long-term commitment to computer literacy at school and increasingly powerful Internet connections are making Koyukuk a very tech-savvy place.

Today, the Yukon-Koyukuk School District integrates Internet-based material and courses into its curriculum for both conventional and special-needs students. This isn't new. In the 1970s the world's first satellite-based distance learning and telemedicine systems were pioneered along the Yukon River.

At Koyukuk's new clinic, local healthcare workers and a team of doctors and specialists in other locations seamlessly work together to diagnose and treat patients using the latest telemedicine technology. Patient data is managed and shared using online electronic medical records. Even dispensing medication has been largely automated, helping to ensure that the right people get the right prescription.

The latest cultural and social events are shared between villages in real time on Facebook. For the older generation—as in communities and families all over the world—younger people are there to lend a hand, helping to strengthen intergenerational ties along the way.

Internet connections keep getting better. Last year, the land-based TERRA network reached Koyukuk with faster speeds and much less delay than the existing satellite network.



The Alaska Native Tribal Health Consortium, through its Rural Energy Initiative, is installing remote monitoring systems to help communities keep their energy systems working efficiently and reliably.

Electronic flow meter measures the amount of hot water circulating through the heat exchanger. Combined with temperature readings, the building control system can calculate the amount of heat delivered.

Smarter Buildings

Building energy systems are just beginning to benefit from the telecommunications revolution. The Alaska Native Tribal Health Consortium (ANTHC) and Alaska Energy Authority are actively developing and deploying an online monitoring system for village energy projects—and Koyukuk will be connected in the near future.

Not only can this system help fix problems when they happen, but more importantly, it can help prevent problems from happening in the first place.

When systems break down. Major failures are usually easy to detect, but can be difficult to fix. Using the Internet, local staff can have immediate and affordable access to factory experts. Those experts, in turn, have real-time remote access to the local control systems. They are able look at performance data to help diagnose the problem, then guide local staff in making needed repairs.

When systems start to degrade. Gradual failures can be very difficult to detect, but easy to fix. As an energy system ages, settings get changed, parts wear, and trained maintenance staff change jobs.

By design, buildings connected to Koyukuk's wood boiler system can maintain comfort even if the wood boiler isn't working properly or if someone forgets to stoke the fire. *Without monitoring, the only indication that there is a problem is a high fuel bill a few months later.*

Southeast Island School District (Prince of Wales Island) science teacher Megan Fitzpatrick uses her school's wood boiler to teach her students about energy and the value of local resources. Koyukuk uses the same type of boiler.

Kaiden Hughes, a high school student in the Southeast Island School District, not only learns about energy in class but also has a part-time job stoking the wood boiler.

Smarter Students

Around Alaska, modern wood boiler systems are helping to educate students.

"The wood-fired boiler itself is an amazing teaching tool," explains Megan Fitzpatrick, a teacher in the remote southeast Alaska island community of Coffman Cove. "We do a lot of BTU comparisons, what types of wood burn best, how much heat you can get out of it, why is it better to use a local wood source..." This school has incorporated data from its wood heating systems into its science, technology, engineering, and math curriculum. Not only does this help create energy-literate citizens ready for tomorrow's workforce, the students can help improve the systems.

The ANTHC is making data from its building monitoring available to everyone. Part of its vision is for these data to help connect people to their energy—and schools are the perfect place.

At the End of the Day

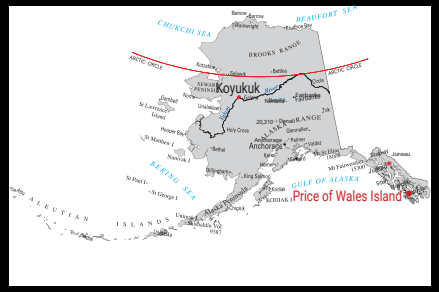
Today, modern wood boilers make heating community buildings with local wood convenient and affordable. By separating the boilers from the buildings they heat, community buildings get reliably, automatically controlled heat with no mess or fuss.

In the near future, when Koyukuk's energy systems are connected to ANTHC's monitoring system, local and remote staff will be able to keep track of performance, alerting them to subtle (and not-so-subtle) problems as soon as they happen.

These wood boiler systems are not only reducing the cost of reliably heating community buildings, but bringing jobs and educational opportunities to Alaska's remote villages.

The Village of Koyukuk

The Village



Getting to Koyukuk

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Health Clinic

Administration Building

The Infrastructure

Wired to the World

Water Plant

Energy

Biomass Heating Plant

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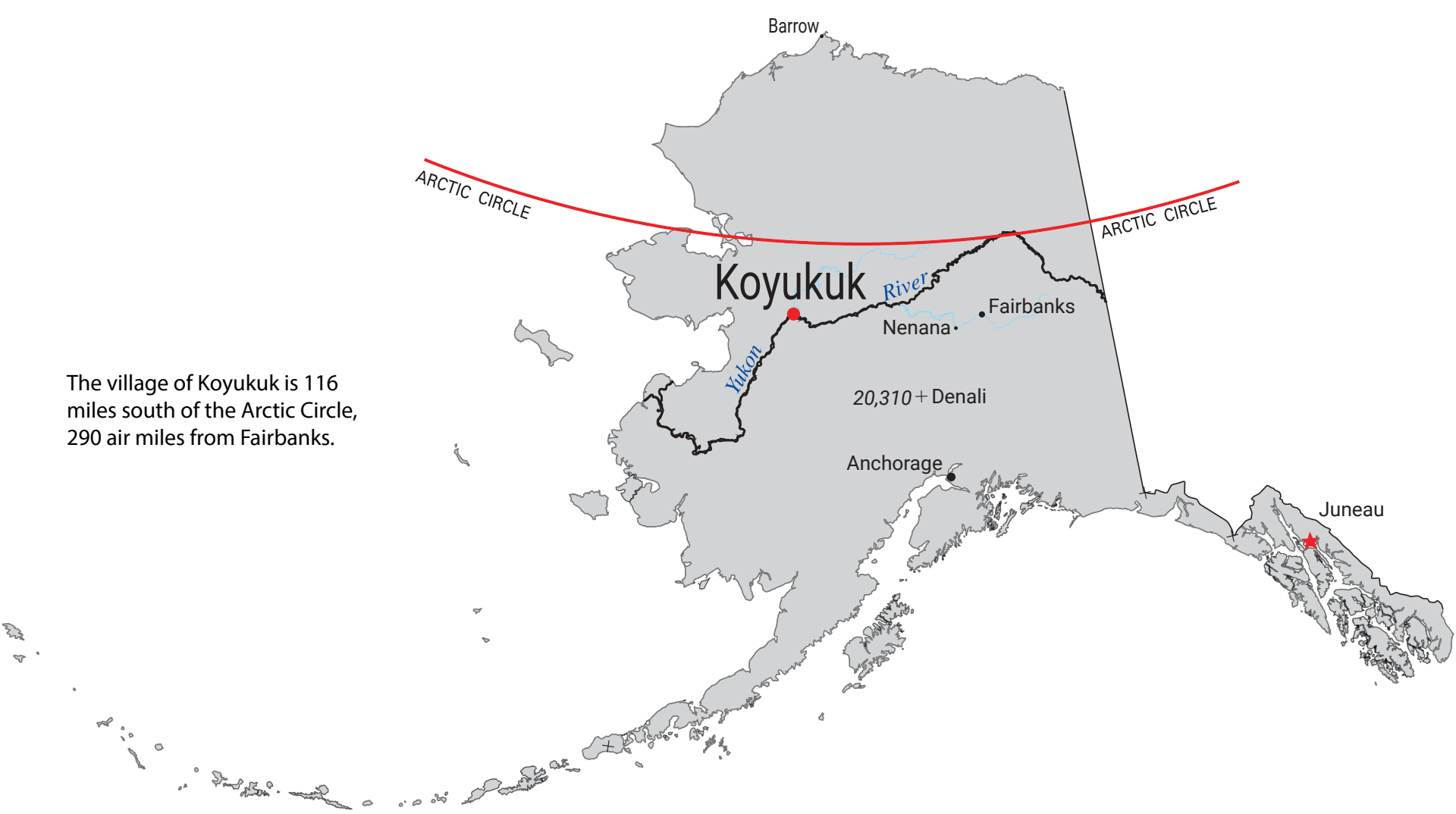


The village of Koyukuk is 116 miles south of the Arctic Circle, 290 air miles from Fairbanks.

Getting to Koyukuk

Where the Yukon and Koyukuk Rivers Meet

Koyukuk is remote, but not isolated. Nulato, 16 miles downriver, is home to nearly 300 people and is one of the region's cultural centers. Galena, 30 miles upriver, has a Native Alaskan population of close to 500. In winter, the frozen Yukon River becomes a highway for the ubiquitous snowmachines—around half an hour to Nulato and an hour or so to Galena.

Final Approach Over the Yukon River

Two hours after leaving Fairbanks, a Cessna Grand Caravan aircraft circles back to make an eastbound approach into Koyukuk Airport (left) over the frozen landscape. This is where the Koyukuk River joins the Yukon River – forming a river three-quarters of a mile wide. The all-season 4,000-foot graded gravel runway can easily accommodate regional propeller passenger planes as well as the C-130 Hercules transport.

Twice a Day—Weather Permitting

Well before the plane buzzes overhead to announce its impending arrival, Vietnam veteran Leo Lolnitz (right) has been on his radio with the pilot and dispatchers discussing all the flight details needed to rapidly turn around people and cargo of the two scheduled daily flights in and out of Koyukuk.

By the time the plane is taxiing into the deplaning area, Leo arrives by snowmachine ready to exchange outbound cargo and passengers with inbound.

Snowmachines Connect Villages

Peter Demoski and his family head off to neighboring Nulato for a community gathering. The 16-mile adventure down the frozen Yukon "winter highway" takes less than 30 minutes.

ATV—All-Terrain Vehicles

All-terrain vehicles are also all-season vehicles. Snowmachines may be faster—when there's snow. But for the summer and shoulder seasons, ATVs, like the one Oscar Dayton drives, are the way to go.

It Wasn't Always That Easy

Eliza Jones (left) is perhaps Koyukuk's most famous resident. From 1973 to 1990, she worked at the Alaska Native Language Center at the University of Alaska Fairbanks, ultimately co-authoring the definitive Koyukon Athabascan Dictionary. This 1,118-page resource, published in 2000, is much more than a dictionary; it is an encyclopedia of the culture of her people.

As a youth, her husband Benedict Jones (above) collected and stacked the firewood that fueled steamships travelling the Yukon River. When he was 19, he got a job feeding driftwood to the boilers of the 237-foot S.S. Nenana, the largest sternwheeler ever built west of the Mississippi.

The S.S. Nenana (above right) connected villages up and down the Yukon and Tanana Rivers to the Alaska Railway depot in Nenana, 45 miles west of Fairbanks. From 1933 to 1957, this sternwheel paddleship moved passengers, freight, and fuel barges. Today, the Nenana is a popular exhibit at Pioneer Village, in Fairbanks.

Today, Eliza and Benedict still stoke the woodstove that keeps their cabin comfortable during the long arctic winter.

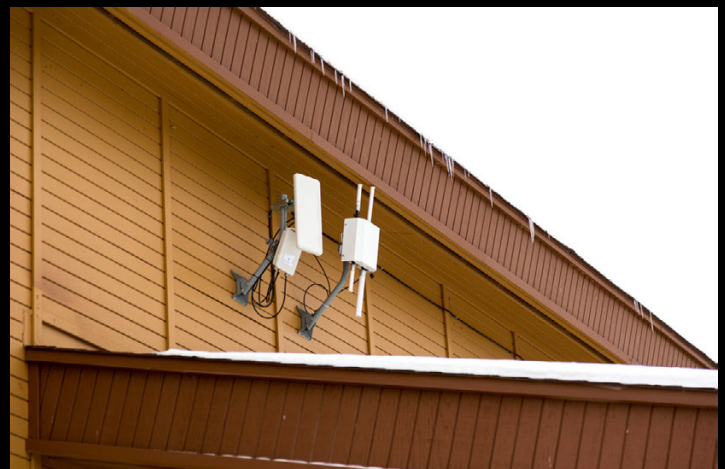
Ella B. Vernetti School, Koyukuk

Recess Time

Playing outside—on all but the coldest days of winter—is part of the curriculum for Morgan "Luna" Malemute (left) and Milla Harris (right) at Koyukuk's Ella B. Vernetti School. The school, established in 1939, is one of six schools in the Yukon-Koyukuk School District.

School Gym

The gym is Koyukuk's largest indoor space, ideal for this evening's supervised after-school recreation and study. When the kids aren't running around, they're playing with their iPads and other Internet-connected gadgets. When Internet service stops at 10 p.m., it is time to go home.



Satellite Distance Learning was pioneered on the Yukon. High-speed Internet access has taken it to a whole new level. Today the library of the world is just a mouse click away.

The Health Clinic

The Meneelghaadze T'oh Health Clinic

On March 31, 2015, the health clinic opened its doors, and ushered in a new era in modern healthcare for Koyukuk.

The 1,400 sq. ft. clinic is equipped with the latest technology for telemedicine, so doctors and specialist in Fairbanks, Anchorage—or anywhere in the world—can diagnose and treat Koyukuk residents.

The clinic is also designed for visiting healthcare professionals, like eye doctors and dentists. The clinic has a fully equipped examination room (upper left) and dental "operatory" (upper right), as well as a comfortable studio apartment (lower right). The building features running water, including a hot shower, and a sewage system.

The new building features the latest in energy-efficient design and construction. It is connected to the biomass heating plant to further reduce operating costs.

Telemedicine

From remote medical examinations, to electronic medical records (EMR), to accurate and secure medication dispensing—high-speed Internet access is seamlessly providing the people of Koyukuk with a standard of healthcare once only found in major cities. Mary Malemute (center), community healthcare worker, makes it sound easy. "We have phone IT support, but it is usually must faster if I just fix it myself."

City and Tribal Administration Building

Previously Unimagined Winter Comfort

"Before we had our building renovated and the biomass installed, our feet used to get cold. We used to be chilly all the time," remarked Josephine Dayton, education employment technician for the Koyukuk Tribal Council. "And now our biggest problem is it's too warm," she added with a smile.

In 2013, the Koyukuk Tribal Council applied for and received a U.S. Department of Energy grant to renovate and weatherize the shared city and tribal administration building. The work began in summer 2014 and was completed by the end of the year. The beautiful log exterior was untouched, but the foundation was replaced and leveled. The inside of the building was completely redone. Floors were replaced, walls and ceilings heavily insulated, and new windows and doors installed.

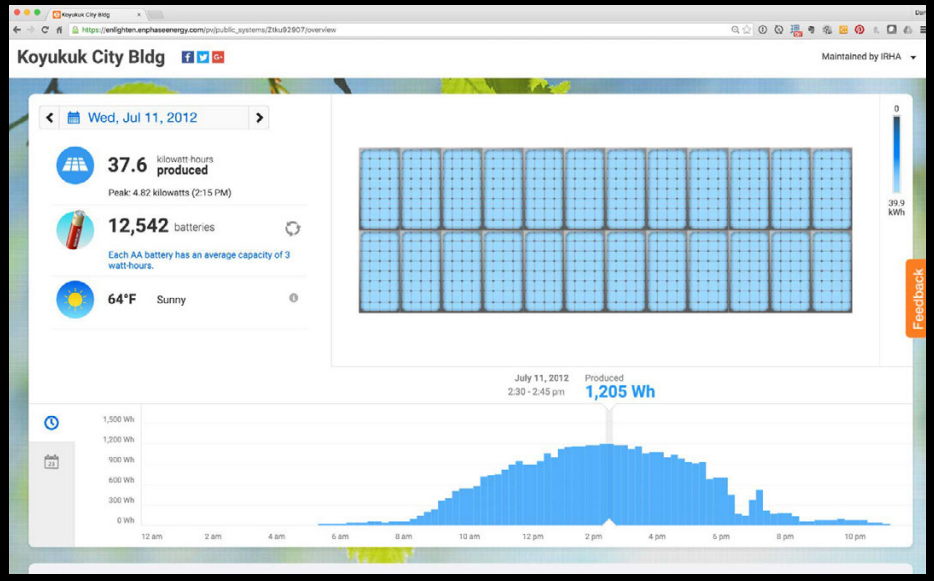
A hydronic, hot-water-based heating system was installed, making the building not only more efficient and comfortable, but compatible with the new biomass heating plant next door.

Not only is the office comfortable in the daytime, it's now a perfect space for Community Wellness coordinator Nadine to bring the village's youth to learn and play in the middle of winter.

Low-Temperature Radiators

These low-temperature (120 to 160 °F) radiators in each office room are safer (they don't burn your hands when you touch them) and a perfect match for a wood boiler, too.

Allowing a wider temperature range for distribution of hot water means that more of the energy stored in the boiler's water jacket can be used before the boiler needs to be stoked. Less frequent stoking helps make operating the plant more convenient and reduces operating costs.



Solar Panels Online

The Land of the Midnight Sun is a pretty good place for solar power. Averaged over a year, a solar panel in arctic Alaska produces about as much energy as a similar panel in Seattle, Washington, or Portland, Oregon.

In summer, the system can produce about 40 kilowatt-hours of electricity each day, saving the power plant about 4 gallons of fuel. Over a year, that works out to $2,000 to $3,000 in fuel savings. Not bad for a 6-kilowatt system.

The panels are sending data to the manufacturer's data center in California. The data can then be viewed by people all over the world—including the classroom across the street.

Wired to the World

As with teens everywhere, nothing beats hanging out with your friends and watching YouTube videos. The Internet has redefined "remote village." Videos of snowmachine races and wrecks were popular this night.

Social media has also made being online a very important part of the bigger, distributed communities. Family and friends in other villages and in the big cities share photos and videos of important regional gatherings in real time, strengthening cultural ties.

Today, satellites provide most of the Internet access (above), but the recently completed microwave link (left) promises faster, more affordable access with a lot less delay.

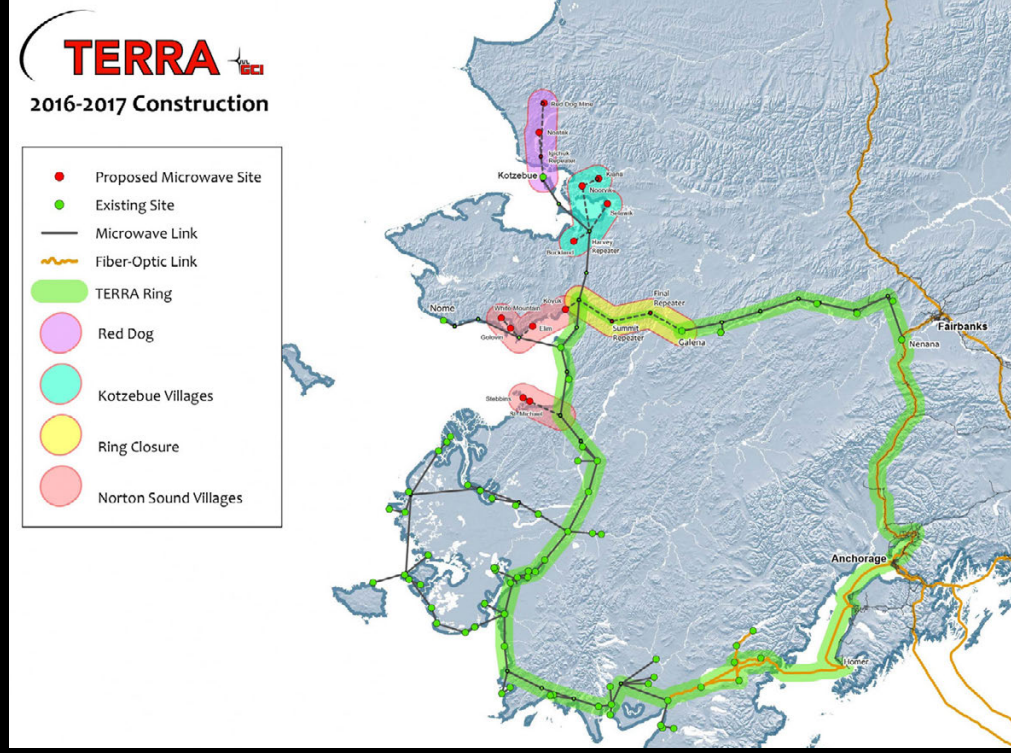
Cheaper and Quicker

As transformative as satellite communications have been, the flow of data is limited, and there's a half-second delay caused by the 45,000 miles the radio waves must travel through space to make contact with a town 320 miles away or another classroom a few hundred miles away. This can be a problem.

By 2017, the land-based TERRA network will be completed, bringing high-speed, low-delay communications to towns and villages in western Alaska.

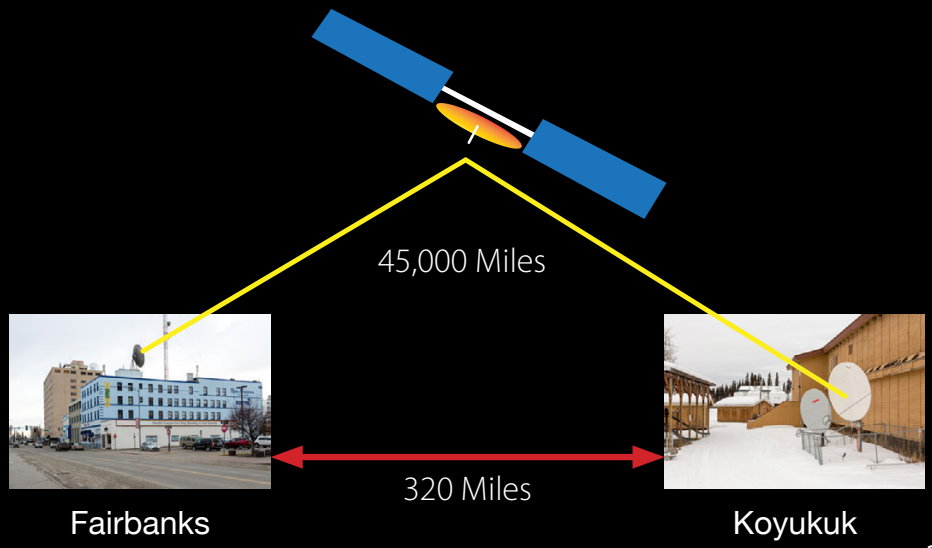
In late 2015, the Koyukuk Health Clinic was connected to this network via a special microwave link to Galena, 25 miles to the south. At some point in the future, the whole village might be connected to this high-speed network and share the benefits of faster Internet access.

Distance learning, telemedicine, and just keeping in touch with family and friends has been made possible because of satellite communications.



GCI

The speed of light—and of radio waves—actually matters. Whether it's the delay when the doctor asks you to stick out your tongue and say "ahh" or when a teacher asks for a show of hands, the delay caused by sending your voice and image into space and back can make for an awkward, inefficient interaction. The delay using ground-based microwave and fiber optic links—including the repeaters and another electronics—is imperceptible to most people. It makes a difference.



Koyukuk Water Plant

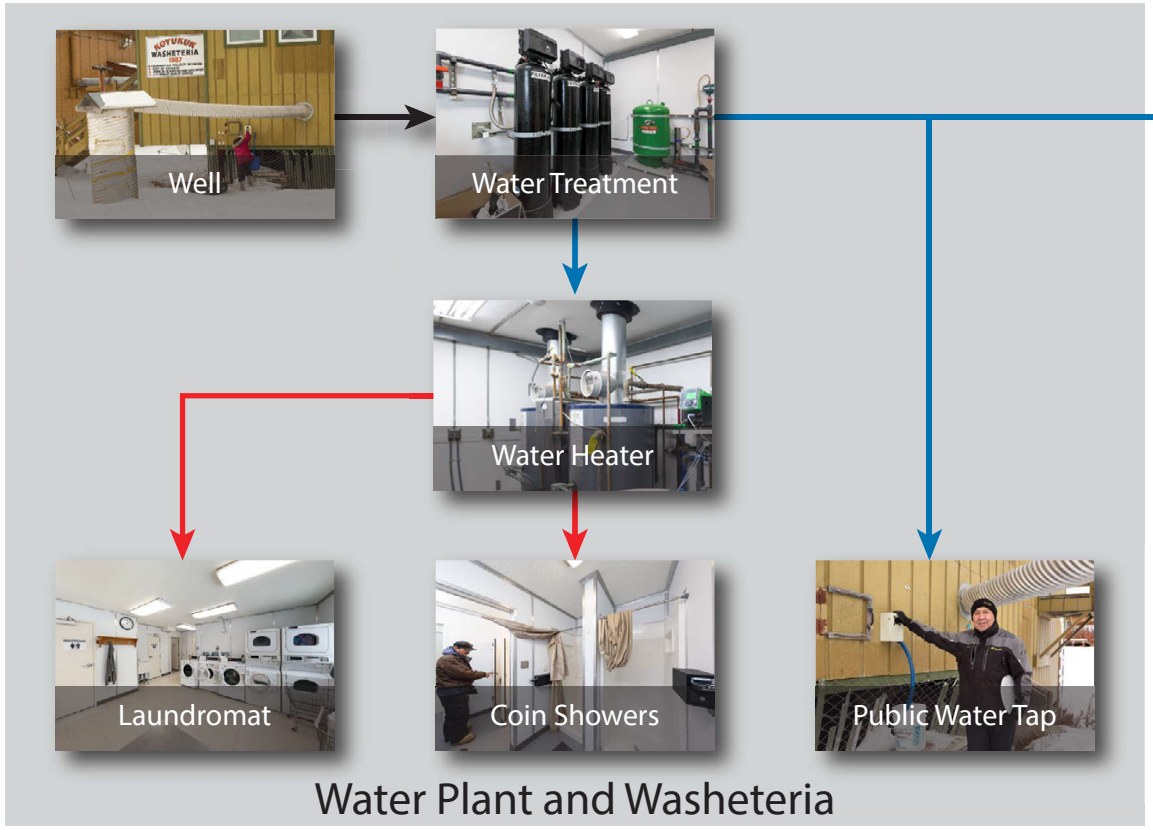
The Water Plant and Washeteria

The village water plant provides clean drinking water for filling tanks, as well as piped/running water to the school, teacher's house, and the new clinic. The water plant also includes a fully equipped "washeteria"—a laundromat, coin-operated hot showers, and restrooms with flush toilets. Most of the heat energy can be provided by the biomass heat plant.

Water Infrastructure

Inside this unassuming building is a complete water treatment plant, a public restroom, a coin laundry, and coin shower. The water plant provides safe drinking water for the whole community. The school, teacher housing and clinic are directly served with running water, but most residents need to haul to water to their homes.

In 2015, ANTHC (Alaska Native Tribal Health Consortium) significantly upgraded the plant to improve drinking water quality (the well water contains high levels of iron, manganese, and total organic carbon), and to improve energy efficiency.



Water Treatment Facilities

Raw water from the community well, which was drilled in 1975, is filtered and treated for drinking water.

The water table varies seasonally with the level of the Yukon River—typically from 5 to 25 feet below the ground surface.

Groundwater is found in an unconfined alluvial aquifer made of unconsolidated gravel and sand, as well as some silt deposited by the Yukon River.

Coin Laundry

Residents of the village come to the public "washeteria" (also spelled "washateria") for hot showers and laundromat, as well as restrooms with running water and flush toilets.

Coin Showers at Four Minutes for $1

For most people in Koyukuk, a hot shower is a few minutes' walk to the Washeteria. In some communities, shower tokens are exchanged for firewood for the wood boiler.

Treated Drinking Water at the Push of a Button

Safe drinking water is available from the village well 24 hours a day at the push of a button. During winter, snowmachines are the transport of choice. Peter Demoski demonstrates how most village residents get their water for drinking and cooking.

Solar Electric PV

The water plant and the shared city and tribal administration building are equipped with solar (photovoltaic, or PV) panels. As PV panel prices drop, the economics for generating electricity from the sun is becoming competitive with conventional sources. This is especially true for off-grid villages that generate electricity from barged-in diesel fuel.

Lower temperatures actually make most PV panels more efficient. On the summer solstice in Koyukuk, the sun rises at 3:36 a.m.—about 2 hours after sunset at 1:29 a.m.

Although not as useful in winter, sunlight reflecting off snow improves PV performance.

The water plant (left) also has solar-hot-water panels.


DIESEL
30,000 GALLONS
GASOLINE
20,000 GALLONS
DIESEL
30,000 GALLONS
STEELFAB
DIESEL
38,100 GALLONS
STEELFAB
DIESEL
38,100 GALLONS

Energy

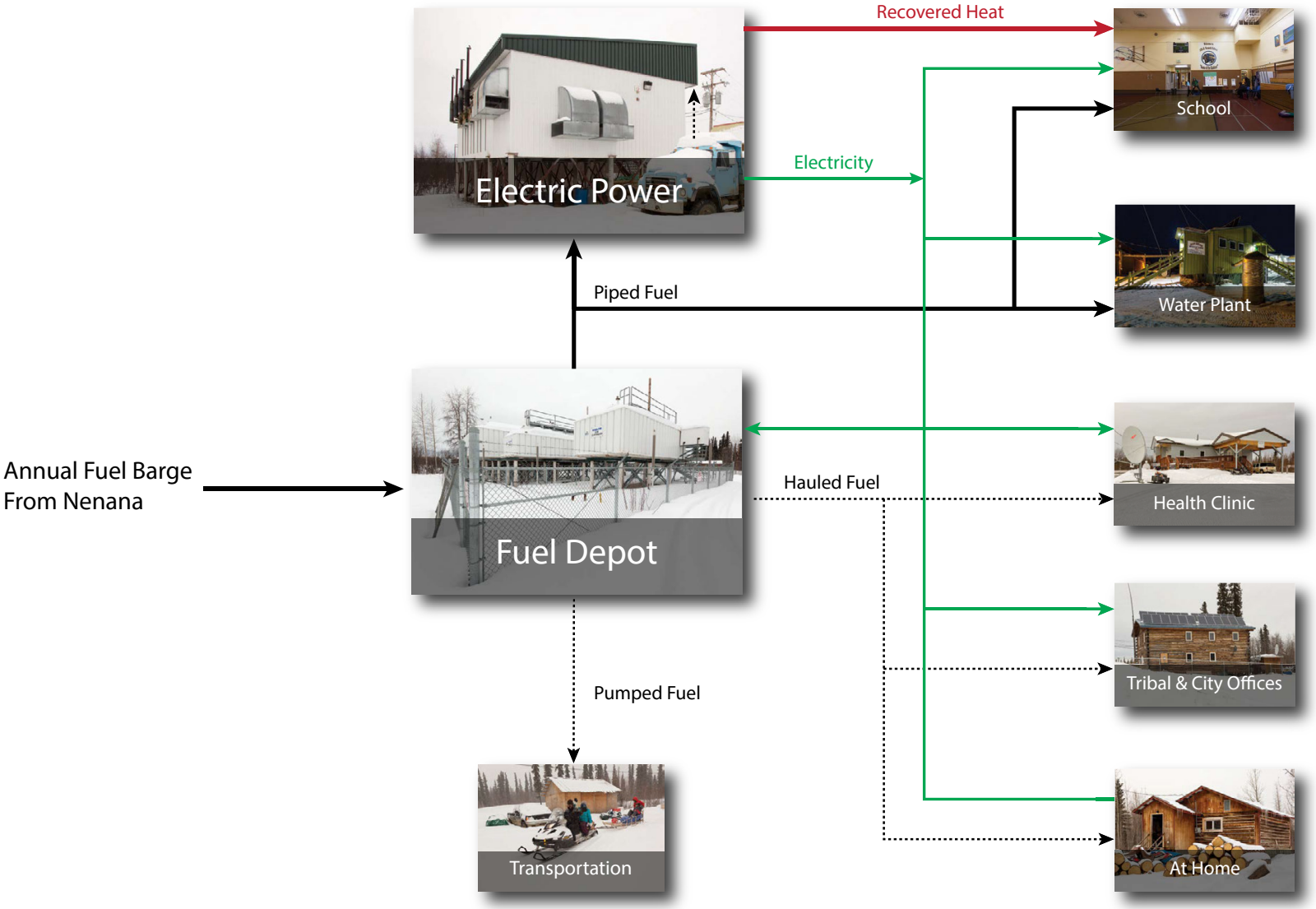
Dual Fuel Cabins

Homes are typically heated with both wood and heating oil.

Cooking Fuels

Most cooking in Koyukuk is done with propane stoves and microwave ovens.

Fossil Fuel Energy



Richard Murphy

Annual Barge—Distance Matters

Each summer, a barge carrying a year's supply of heating fuel and gasoline travels more than 350 miles down the Tanana and Yukon Rivers from Nenana. That trip nearly doubles the price. In 2015–2016, heating oil cost $6.50 a gallon in Koyukuk.

Its cargo is pumped through hoses that connect to these off-loading quick-connect adaptors and then through pipes into Koyukuk's fuel depot.

Capacity for 121,900 Gallons of Fuel

Heating oil here is diesel fuel #1, a kerosene product like jet fuel that can flow freely at these extreme temperatures. It is used to heat homes and buildings, as well as to run the diesel generators.

In 2004 and 2005, the city replaced its aging fuel tanks (left) with this modern tank farm (above) to reduce the risk of fuel spilling into the Yukon River during floods. The new tank farm holds 88,900 gallons of heating oil (including 17,000 gallons owned by the school) and 33,000 gallons of gasoline.

Piped Directly to These Buildings

Diesel heating fuel is pumped through underground pipes to the school (upper left), water plant (upper right), and electric power plant (lower left). This not only makes fuel delivery more reliable and convenient, it also dramatically reduces the possibility of fuel spills and ground contamination.

Heating Oil Customers →

← Gasoline Customers

The Koyukuk Power Plant

Virtually all the homes and buildings are connected to the city-owned Koyukuk Electric Company's microgrid. The four diesel generators inside the power plant (above) can easily and reliably provide the village peak demand of nearly 60 kilowatts. On average, the power plant uses about 85 gallons of diesel each day.

Streetlights

The electric company also provides unmetered electricity to the village's numerous streetlights—an important service in a place just 115 miles south of the Arctic Circle, where December nights can last more than 20 hours. The older streetlights, like this one in front of the Community Hall (above), use efficient high-pressure sodium lamps. The newer streetlights near the clinic use ultra-efficient LEDs.

Biomass Heating Plant

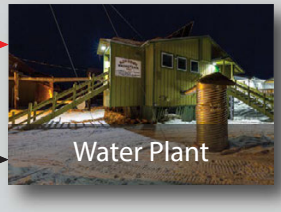
Wood Boiler in Operation

The boiler operator opens the greenish-silver hatch on the front of the boiler and loads cut firewood into the fire box, makes sure the fire is lit, and walks away. The weather determines how often the boiler needs to be stoked—from once or twice a week up to three times a day when it is really cold outside.

Divide and Conquer

Making Heat

Using Heat



Hauled Fuel

Recovered Heat

Piped Fuel

Annual Fuel Barge From Nenana

Local Jobs

Alfred Dayton, one of the biomass heat plant operators, splits the wood (left) and feeds and starts the boiler (right).

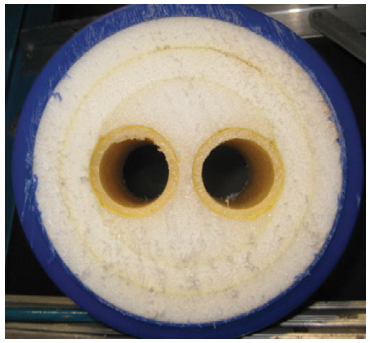
Gathering and processing firewood can be done throughout the year whenever it is convenient for the people doing this work—very compatible with a subsistence lifestyle. Once cut, it takes a year or so before the wood is dry enough to burn cleanly and efficiently.

Operating and stoking the boiler is less flexible, but is a good match for people who need to stay in the village because their children are going to school.

District Heating 101

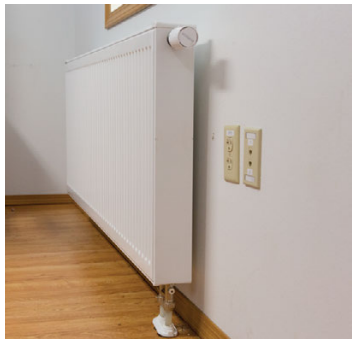
Wood Boiler

Pump

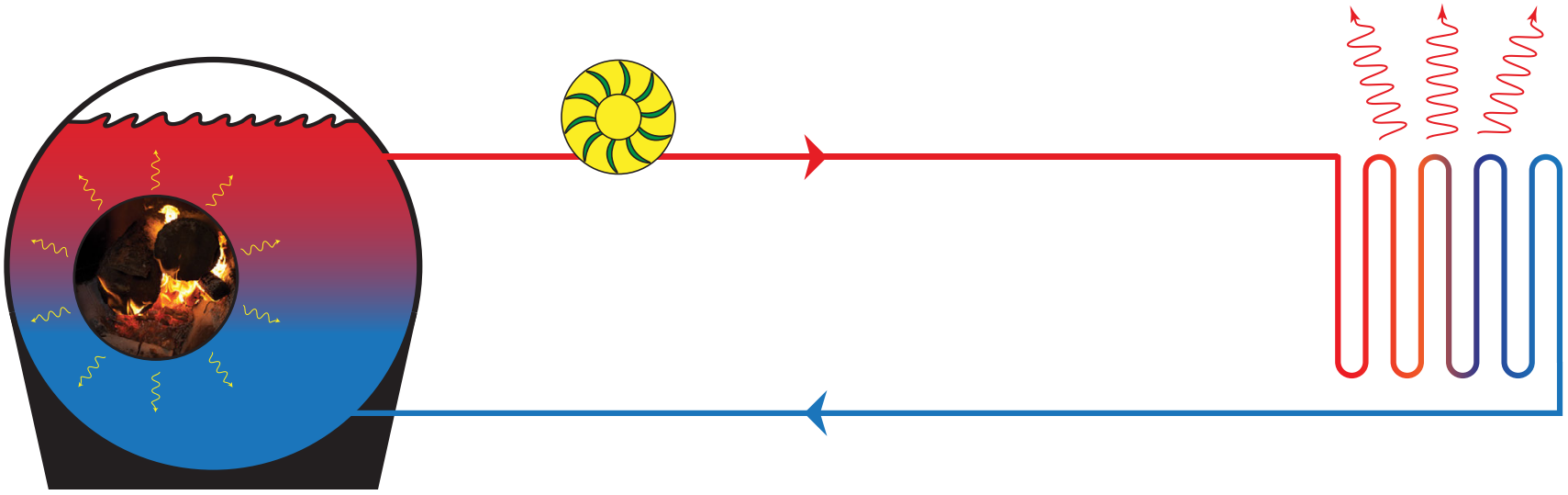


Dan Parrent

Insulated Pipe

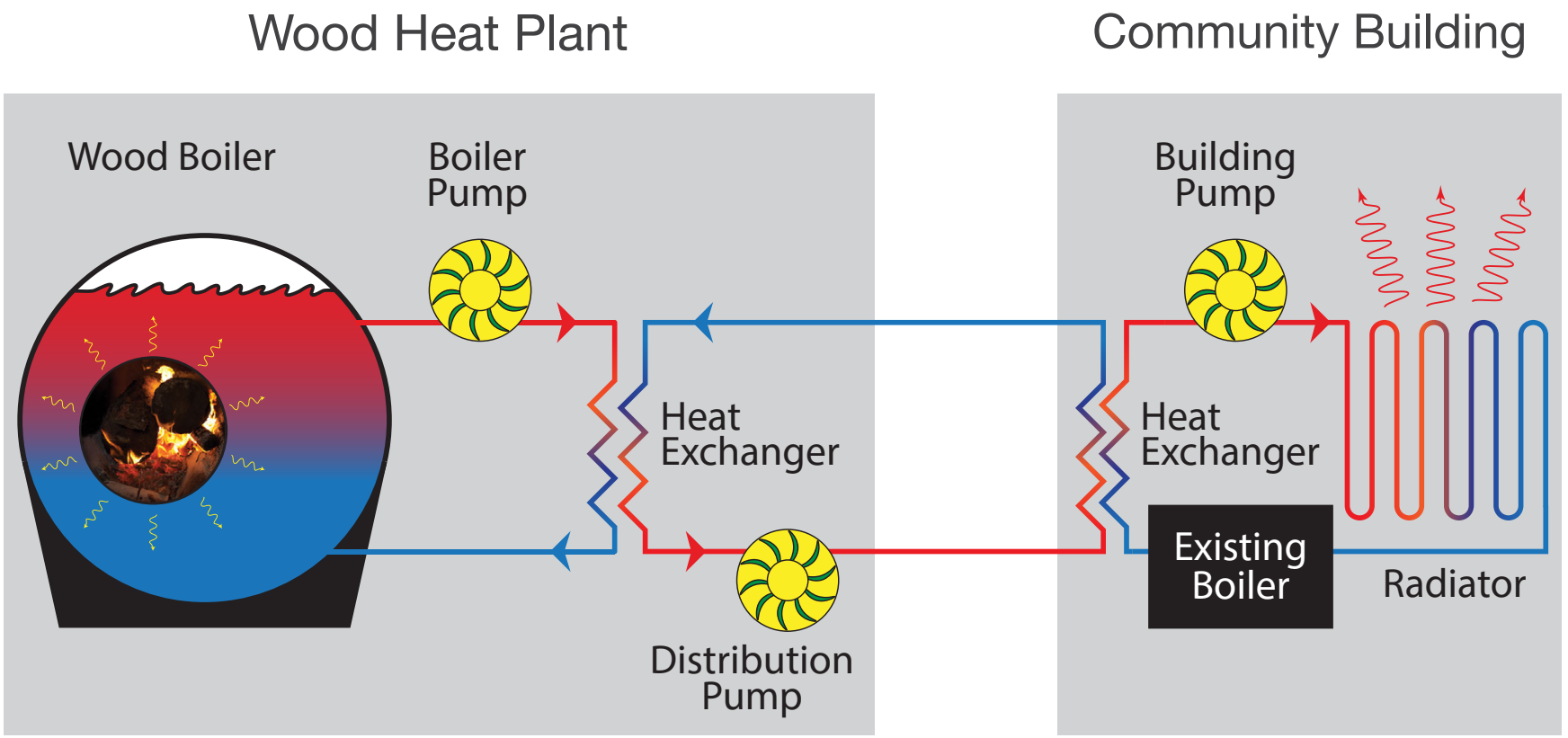


Radiator



Using water to move heat isn't a new idea. But with advances in plastic piping and electronic controls, these "hydronic" heat distribution systems are more reliable and affordable than ever.

District Heating 102

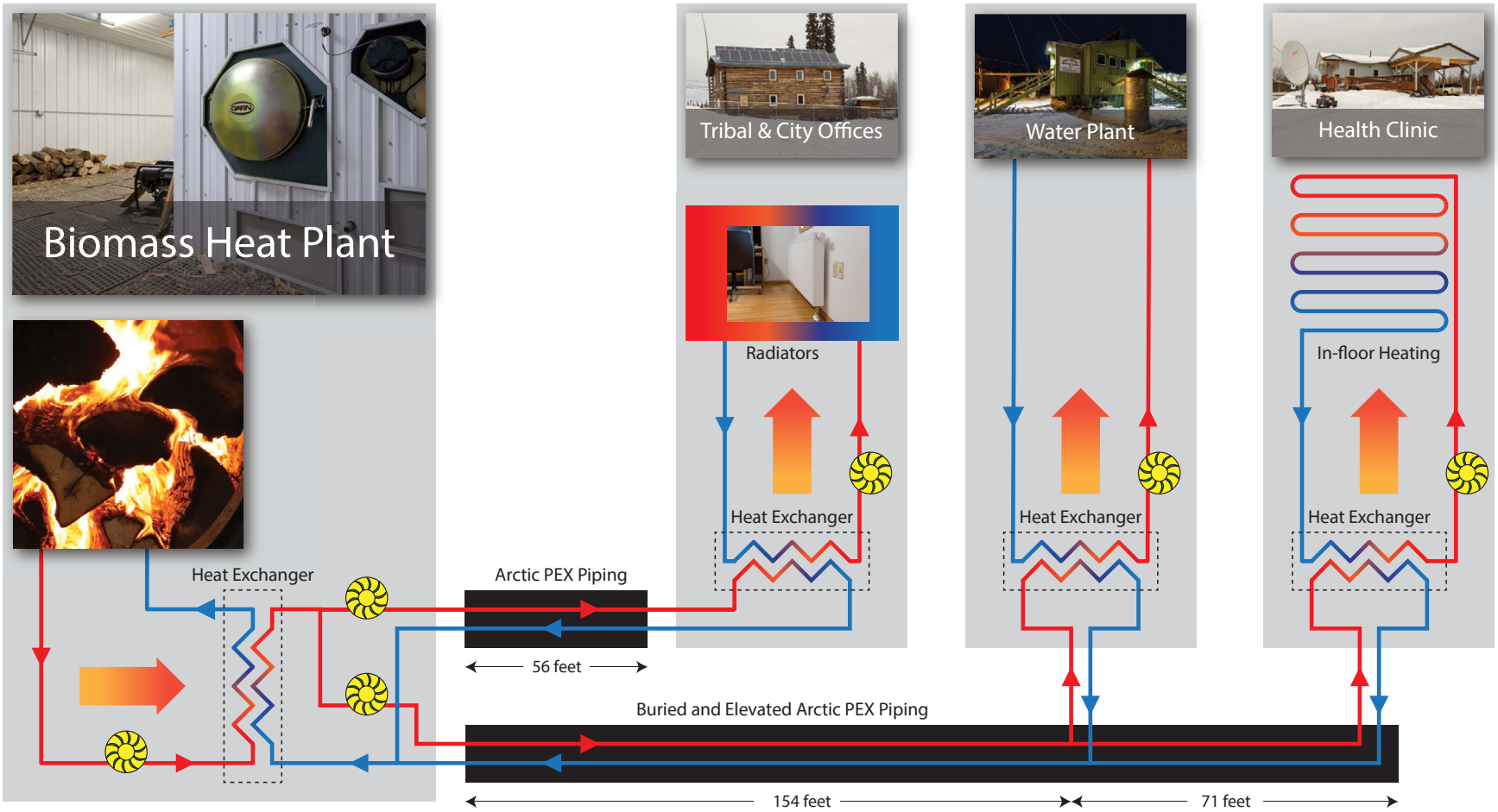


Directly circulating hot water to many buildings can work, but if there is a leak or failure anywhere in the heating loop, the whole system stops working.

A much more reliable and robust approach is to divide and isolate the heating loops using a device called a heat exchanger. Like its name suggests, it transfers heat from one loop to another. The heat moves, but the water doesn't mix.

If the biomass heating plant stops working or can't provide enough heat, the conventional heating system in each building automatically takes over.

Koyukuk's Wood Boiler District Heat System



Putting it all together. Koyukuk's Biomass Heat Plant currently provides heat for three buildings—the shared city and tribal administration building, water plant, and health clinic—through buried and elevated insulated Arctic PEX piping. (PEX is the common abbreviation for "cross-linked polyethylene," a type of plastic suitable for the 180 °F hot water.)

District Heating Interface

All it takes to connect a building like the shared city and tribal administration building to a district heating loop is a heat exchanger like this one (left side of photo) and a building that has a hot water (hydronic) heat distribution system.

Modern Building Control Systems

Increasingly, building controls and control systems can be connected to the Internet. Once connected, remote technicians can help local staff fix problems. Automatic performance monitoring can help detect problems before they happen—and help keep the building running efficiently.

Pacific Northwest Research Station

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