Yukon Energy

Whitehorse Generating Facilities

photo: www.archbould.com

yukon energy

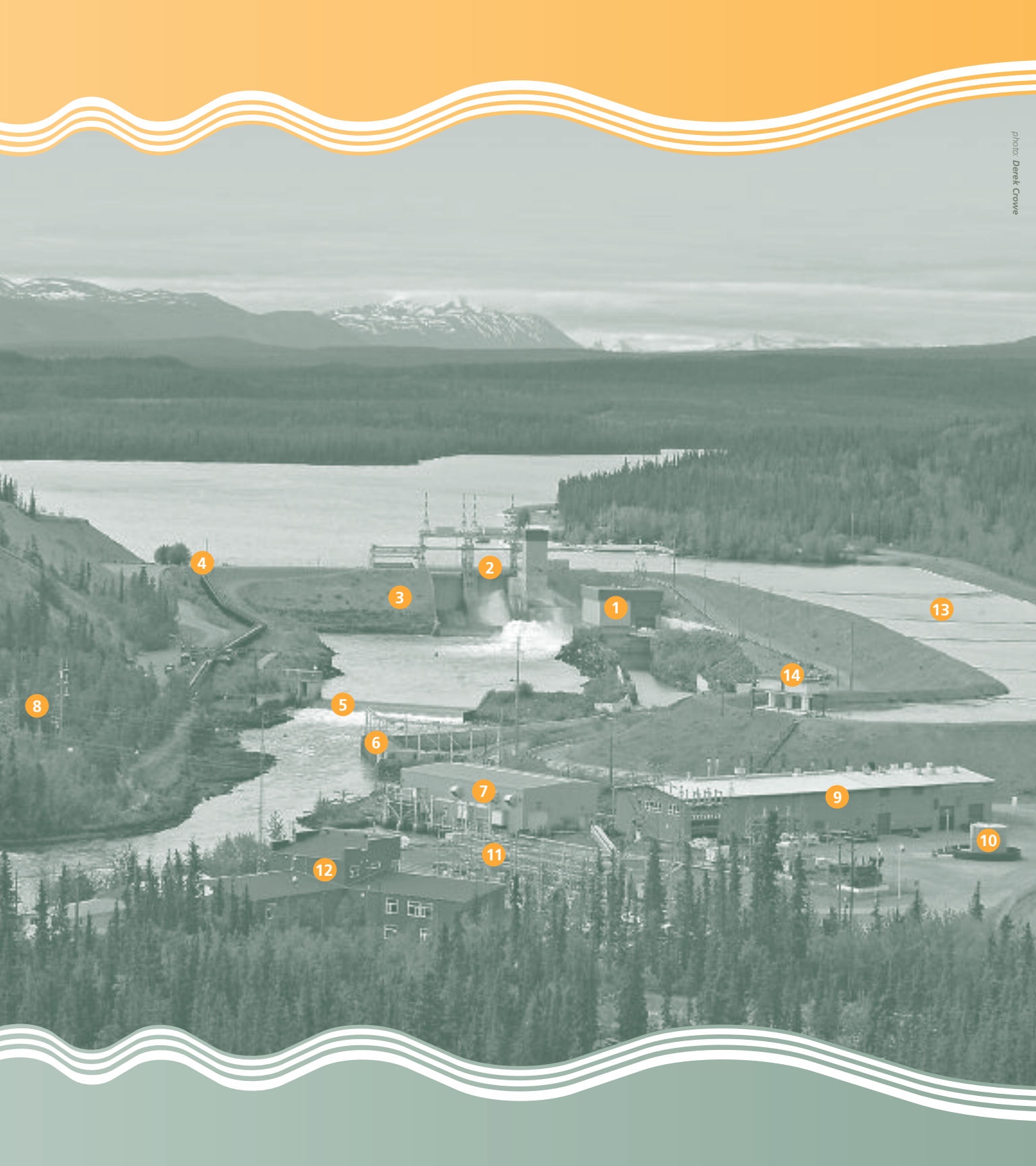

photo: Derek Crowe

Let Us Introduce Ourselves

Yukon Energy is the main producer and transmitter of electricity in the territory. Our power comes primarily from hydro, with a small percentage from wind. We also have diesel generators in several Yukon communities, but they are only used as emergency back-up.

Yukon Energy has three hydro plants — one at Whitehorse on the Yukon River, one located at Aishihik Lake, and one in Mayo in the central Yukon. Together, the facilities have the ability to generate 75 megawatts (75 million watts) of power.

A Tour of the Whitehorse Dam

1. Hydro turbine #4, known as the 'Fourth Wheel'
2. Spillway — water not needed to produce electricity is spilled into the Yukon River
3. Dam
4. Fishladder — allows migrating salmon and other species of fish to travel past the dam
5. Fish weir — directs fish towards the fishladder
6. Fish screens — also help direct fish towards the fishladder
7. Hydro turbines #1, 2 and 3
8. Switching station — sends electricity to various communities
9. Seven back-up diesel generators
10. Diesel storage tank
11. Substation — gives electricity a voltage boost to help it travel along power lines
12. Yukon Energy's corporate office
13. Power Canal — moves water from Schwatka Lake towards the intake to hydro units #1, 2 and 3
14. Gate House — controls the flow of water to the penstock

Our largest hydro facilities are located in Whitehorse where we have the capability of producing 40 megawatts of power. There are several components at the Whitehorse Rapids Generating Facility that work together to create electricity.

Dam

One of the first things you'll notice is our dam (*number 3*). It's a large steel, earthen and concrete structure that holds back water from Schwatka Lake. In the summer and fall, when we sometimes have more water than we need to make electricity, we spill some of the lake water through our spillway (*number 2*).

Power Canal

Our facility is built in such a way that some of the water from Schwatka Lake moves into a long and narrow area called a power canal (*number 13*). There are trash gates in the canal to catch any fallen trees or other debris. There are also a series of log booms in the canal that calm the water and help prevent erosion of the canal banks.

Gate House

The small building at the end of the power canal is called the gate house (*number 14*). When doing maintenance or repairs to our generating equipment, gates from this structure are lowered to stop the water from flowing from the canal through large tunnels (known as the penstock) to our turbines.

photo: **Derek Crowe**

photo: **Yukon Energy**

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Hydro Turbines/Generators

From the power canal, the water falls through the penstock and hits the blades of our hydro turbines, making the blades turn. Three of the turbines are at the end of the power canal (*number 7*) and our newest turbine, which we call the Fourth Wheel, is at the top of the canal (*number 1*).

The turbine blades are attached to generators that make electricity. Once the water hits the turbine blades, it flows back into the Yukon River.

Diesel Generators

We use water to produce almost all of our electricity, with a small amount of power coming from two wind turbines on Haeckel Hill near Whitehorse. We only use diesel as back-up. However, it's important that we maintain our seven diesel generators (*number 9*) so they can be fired up when necessary. We have a diesel storage tank (*number 10*) that holds enough fuel to keep our diesel generators running for 24 hours.

Substations and Switching Stations

Once electricity is produced, it moves through power lines to a substation. Substations (*number 11*) give electricity a voltage boost (voltage is the strength at which electricity moves) to help it travel along power lines to Yukon communities. Across the Yukon River is a switching station (*number 8*) that sends electricity to various communities.

left clockwise
dam; spillway; front side of dam, with power canal on the left

above left to right
refurbishing one of the Whitehorse hydro units

Fish Ladder

When the dam was built, salmon and other fish couldn't travel this part of the river as they had in the past, so special equipment was built to help them maneuver past our facility. A wooden fish ladder (*number 4*) allows the fish to move between Schwatka Lake and the part of the Yukon River below our dam. The 366-metre fish ladder is one of the longest wooden fish ladders in the world.

There's an interpretive centre at the fishway that tells the story of the migrating chinook salmon. The facility has underwater viewing windows and TV screens so you can see the fish as they swim by.

Fish Screens and Weir

Screens are put in the water in the summer time to stop the fish from swimming into the water that's just run through our turbines (*number 6*). As well, a concrete weir (*number 5*) and an underwater canal guide the fish towards the fish ladder and away from our turbines.

Award Winning Building

Before finishing your tour, take notice of our office building (*number 12*), built after our old one was destroyed in a fire in 1997. The new building has won a national design award for energy efficiency.

Along with being our Corporate Headquarters, this building houses our control centre, which allows operators to control and monitor 23 hydro and diesel generators throughout the Yukon, our transmission facilities and our five sub-stations. A few key strokes on a computer keyboard can start and stop generators or open and close breakers hundreds of kilometres away.

below left to right
fish ladder;
corporate headquarters building

photo: ***Rob Ingram***

photo: ***Peter Long***

photo : **Derek Crowe**

photo: **Yukon Archives, Emil Turquist fonds, 82/399 #83**

photo: **Yukon Archives, Emil Turquist fonds, 82/399 #92**

above
control centre

right
construction of dam

photo: **Yukon Energy**

Interesting Facts

The Whitehorse Rapids generating facility was built in 1958 at a cost of $7.2 million.

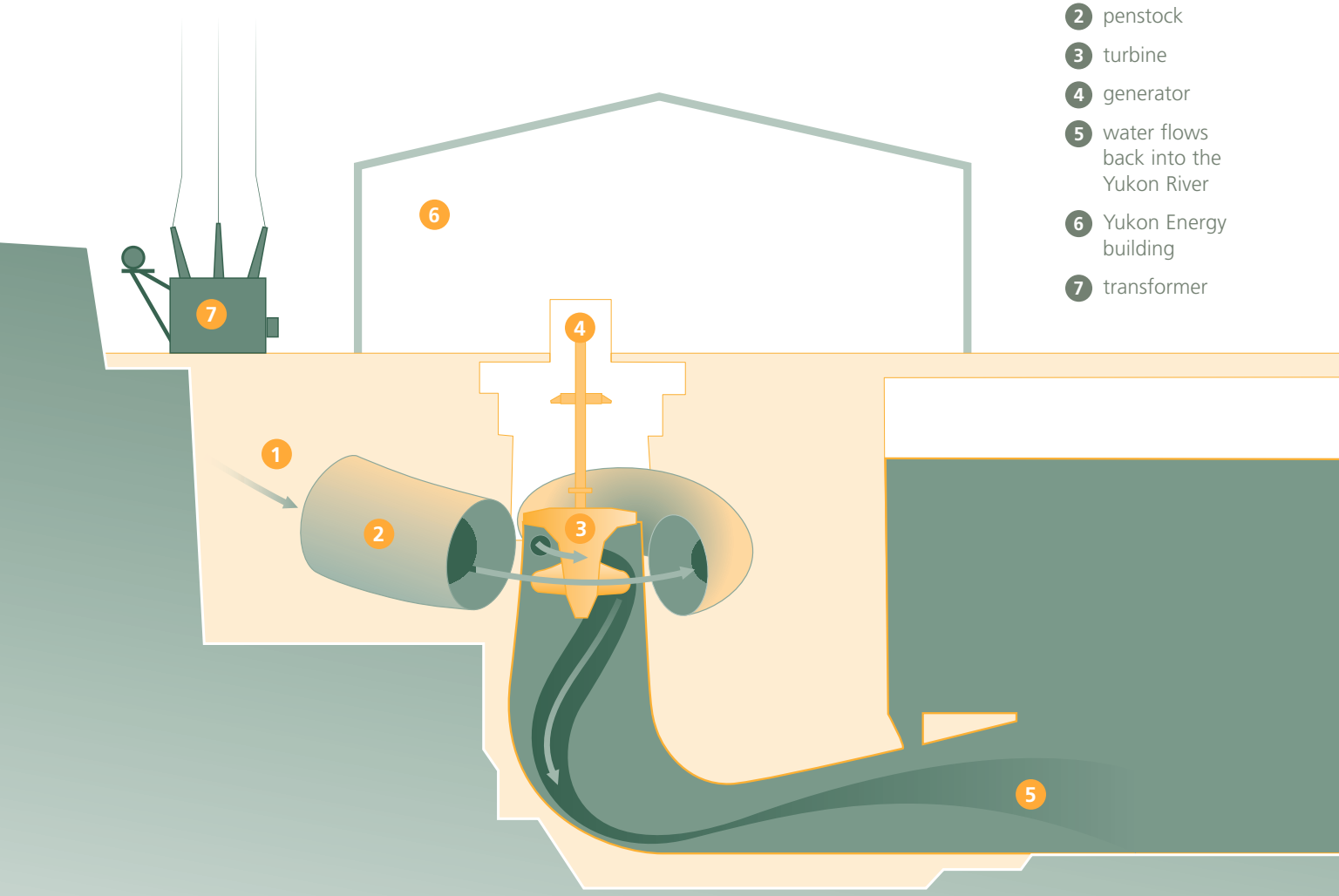
It began with two hydro turbines and in 1969 a third one was added. A fourth turbine was installed in 1985 (referred to as the "Fourth Wheel") which doubled the hydro capacity of this site.

The Whitehorse hydro facility can produce 40 megawatts of power, which is enough to light up one million 40 watt light bulbs. (Yukon Energy also has a hydro facility near Aishihik Lake that can produce 30 megawatts of power and one in Mayo that produces five megawatts.)

On a very cold day, Yukon Energy needs to produce between 50 and 60 megawatts of power to supply the needs of Yukoners. On a milder day, that number drops to between 20 and 35 megawatts.

The dam holds back between eight and 13 billion litres of lake water. Between 90 and 277 cubic metres per second of water goes through our turbines to create electricity. This number varies depending on how much electricity we need to generate. The more power we need, the more water we allow to pass through our turbines. The water that's not needed to generate electricity is spilled through our spillway.

Changing Water into Electricity at Yukon Energy



1. river water flows into the penstock
2. penstock
3. turbine
4. generator
5. water flows back into the Yukon River
6. Yukon Energy building
7. transformer

What is electricity?

Electricity is a form of energy that starts with atoms. There are three parts to an atom: protons, neutrons and electrons. Electricity is created when electrons move from atom to atom. There are a number of ways to make electrons move, but most electricity is produced at power plants.

How do power plants work?

It all starts with a source of power. At Yukon Energy, we use water (number 1) to create most of our electricity. Our Whitehorse plant, for instance, uses water from the Yukon River. The water is directed through large underground pipes or penstock (number 2) and falls against the blades of giant turbines (number 3). The turbine blades are attached to generators (number 4) that create electricity.

What happens to the electricity after that?

It moves through wires into a power transformer (number 7). The transformer boosts the electrical voltage (the strength at which electricity flows) to help it move through aluminum or copper transmission lines. Electricity travels at the speed of light—about 300,000 kilometres per second, to get to your home or business! Once there, another transformer adjusts the voltage so you can safety use the electricity.

right top to bottom
transformers; refurbishing a turbine; penstock

below
Whitehorse in winter at night

photo: ***Yukon Energy***

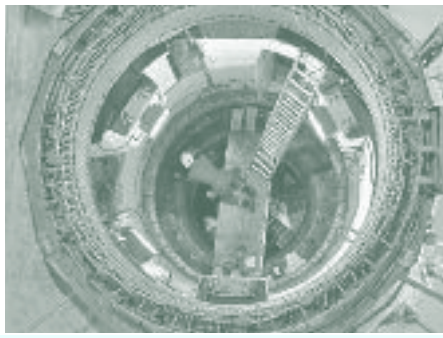


photo: ***www.archbould.com***

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photo: ***Yukon government***

Yukon Energy's Wind Facilities

Of all the mountain viewpoints in the Whitehorse area, Haeckel Hill is one of the most noticeable. That's in part because the two Yukon Energy wind turbines on top of the hill make it a very distinctive landmark.

The smaller of the two turbines is a 0.15 megawatt unit that was installed in 1993 at a cost of $800,000. The larger turbine, which cost $2 million, was erected in 2000. It can produce 0.66 megawatts of power. Together, the turbines can provide clean, renewable energy to 150 homes.

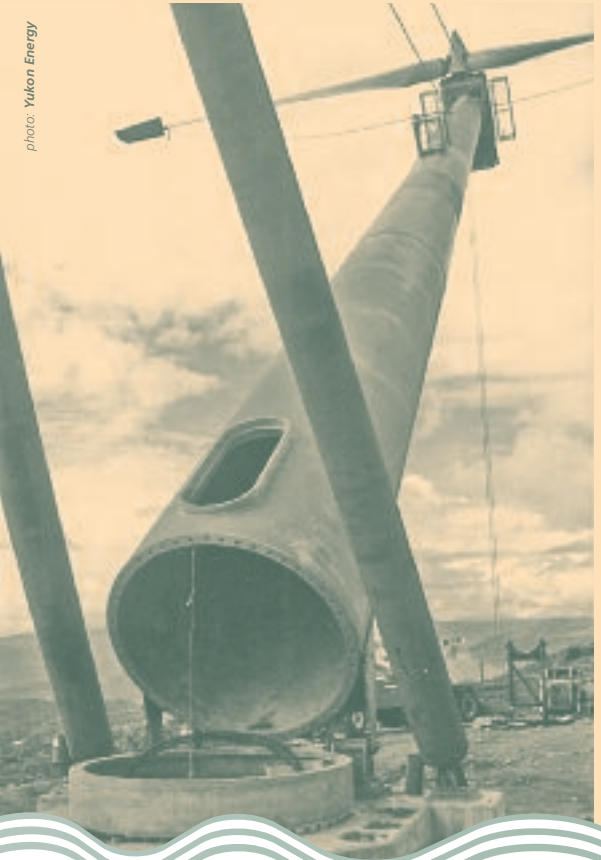


photo: ***Yukon Energy***

The History of Wind Power in the Yukon

After a number of disappointing trials in the 1980s, the National Research Council (NRC) and the Yukon government almost wrote off wind generation in the Yukon. However, wind got a second chance from two long-time Yukoners, Dr. Doug Craig and Jack Cable.

Thinking that wind potential might be better at higher elevations, Craig dug through records of Whitehorse weather balloon information from Environment Canada. He observed that good wind velocities did exist at higher altitudes. Encouraged, Craig and Cable set up the Boreal Alternate Energy Centre in 1990 to explore energy options.

Boreal rounded up two NRC wind monitoring instruments left in the north from previous studies. With a truck loaned by the Yukon Electrical Company Ltd. and a $1,500 contribution from Yukon Energy, Boreal was able to erect its first tower at the 1,430-metre level on Haeckel Hill.

Despite instrument icing problems, Boreal demonstrated that Haeckel Hill experienced 10 times more wind energy than the Whitehorse airport.

In 1991 and 1992, instruments on Mount Sumanik at 1,550 metres and on nearby Flat Mountain at 1,940 metres revealed 15 percent and 30 percent wind energy increases respectively. By late 1992, Yukon Energy was negotiating with Bonus A/G of Denmark to purchase our first wind turbine and it was erected the following year.

left to right
erecting the first wind turbine;
installing the second wind turbine

photo: **www.archbould.com**

The Second Turbine

Yukon Energy's first turbine established the technical feasibility of wind generation in Yukon conditions. The second larger turbine was erected to test the commercial viability of wind generation; that is, the ability to use wind to generate electrical power at costs below those of diesel generation in the territory.

It was quite a feat to get this turbine to its final destination; the tower itself was built in North Dakota but other parts of the turbine came from all over the world. The road up Haeckel Hill wasn't adequate to handle a turbine of this size (37 metres from base to hub), so the road had to be widened in places. Getting a 180-tonne crane up the mountain wasn't easy even with the road upgrades.

photo: **www.archbould.com**

Through operating these two wind turbines, Yukon Energy is demonstrating that wind power has promise in northern locations. However we still have some technical difficulties to overcome before we can say that wind energy is a viable alternative for the Yukon. The single biggest obstacle to wind power generation is rime icing. It's a frost-like build up of ice that occurs when a cloud comes in contact with a mountain. The ice appears to 'grow' into the wind, causing trees to become ice domes, towers to become ice posts and power lines to grow to six or eight inches in diameter. Rime icing can cause a significant loss in energy production.

Yukon Energy has made some modifications to our turbines to help cut down on rime icing, including heating the blades and applying special paint to them that helps shed the ice. We continue to look for ways of making rime icing less of a challenge.

photo: ***Yukon Energy***

above
rime ice

photos: ***Derek Crowe***

above left to right
repair and maintenance of the second turbine

photo: **www.archbould.com**

Interesting Facts about the Haeckel Hill Wind Turbines

Seen from downtown Whitehorse, if the blades appear to turn clockwise, the wind is from the south. If they're turning counter-clockwise, the wind is from the north. If the blades are not turning, there is insufficient wind, the equipment is down for maintenance or they have been automatically stopped because it is too windy. Allowing the blades to turn in excessively windy conditions could damage the units.

The wind turbines normally produce power about 70 percent of the time during the winter months, dropping to less than 50 percent in the calmer summer months.

above
inside the second wind tower

behind
wind turbines on Haeckel Hill

photo: **www.archbould.com**

Changing Wind into Electricity at Yukon Energy

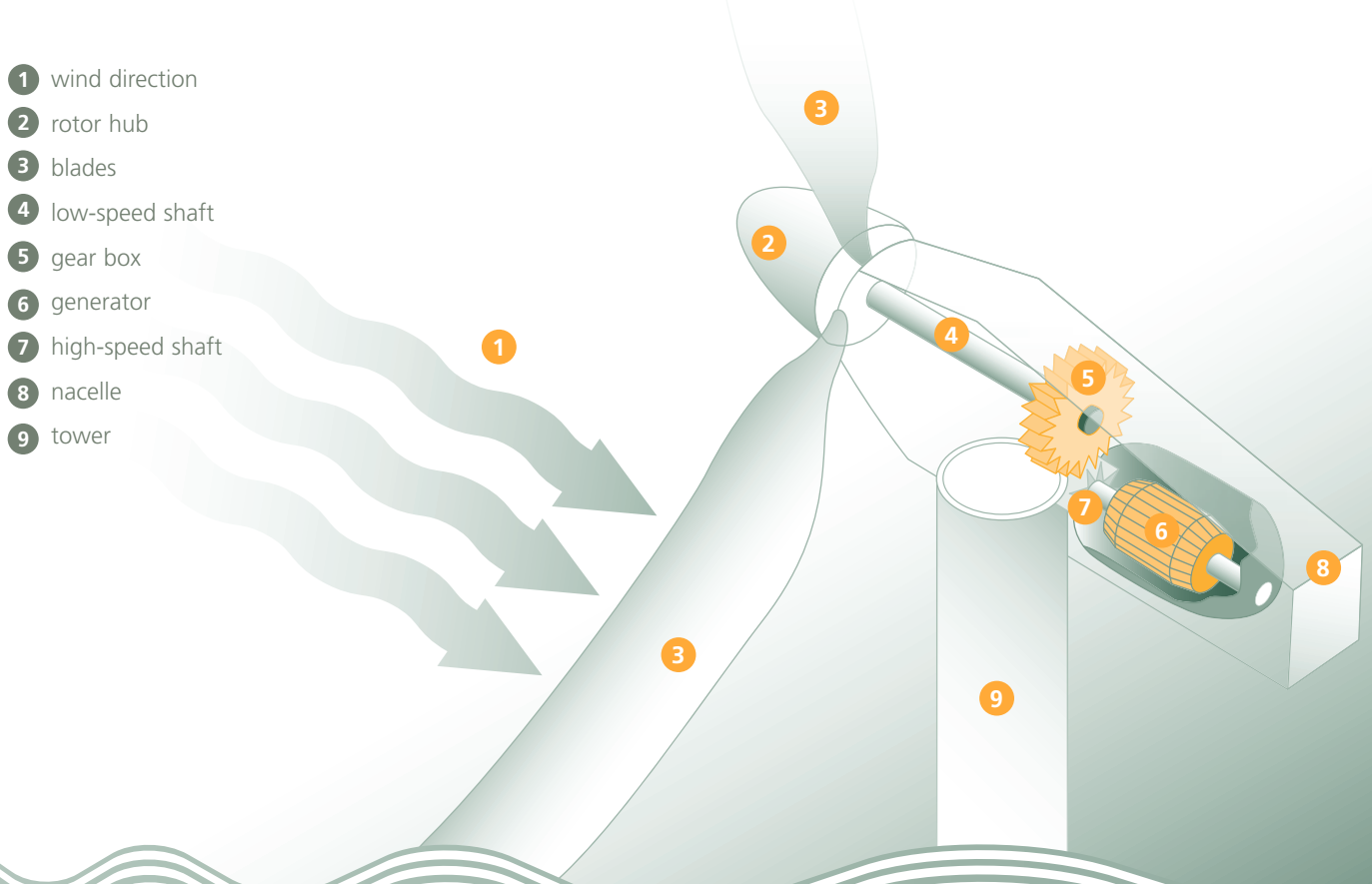
How do wind turbines make electricity? Simply put, the wind turns the blades, which spin a shaft, which connects to a generator and makes electricity.

At the top of the wind tower, you will see a rectangular enclosure. This is called the nacelle (number 8) and houses the components that generate electricity. The rotor blades (number 3) turn in the wind and transfer the wind power to the rotor hub (number 2). A shaft is connected to the hub (number 4), and it makes about 30 to 60 rotations per minute.

However the rotational speed must be much faster for generators to work, so a piece of equipment called the gear box (number 5) connects this first shaft to a second one (number 7), which can make about 1,200 to 1,500 rotations per minute.

The high speed shaft turns an electromagnet in the generator (number 6), creating electrical energy. This energy is carried down the wind tower (number 9) through cables to transformers, where the voltage is increased so it can travel easier through transmission lines to homes and businesses.

1. wind direction
2. rotor hub
3. blades
4. low-speed shaft
5. gear box
6. generator
7. high-speed shaft
8. nacelle
9. tower



Touring Our Facilities

If you'd like a tour of our Whitehorse hydro facilities, call (867) 393-5333 or email communications@yec.yk.ca.

Please note it's necessary to contact us at least one week in advance of your preferred tour date. Based on staffing and operational requirements, we will find a time and date that works for both you and Yukon Energy.

We must have a minimum of six people to offer a tour. For large groups such as school classes, the students will be broken into groups of no more than 10 each. Please provide at least one adult chaperone per group.

The tour lasts approximately an hour and a half, although it can be adjusted to suit your available time. Note that the tour requires a fair amount of walking. Not all our facilities are, as yet, wheelchair accessible.

For more information about Yukon Energy's facilities and the services we provide, visit www.yukonenergy.ca.

photo: **Yukon Energy**

photo: **Yukon Energy**

above and behind
school children touring the Whitehorse facilities

Yukon Energy Corporation

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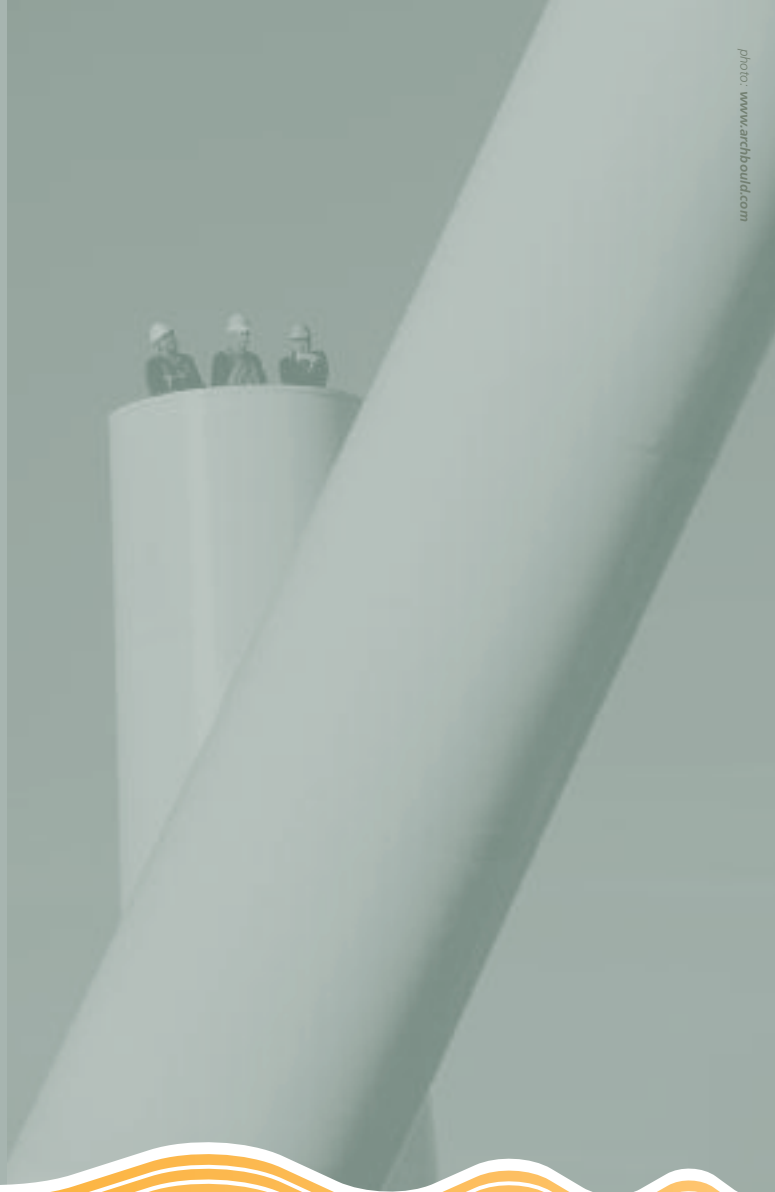
Yukon Energy provides reliable and cost-effective energy services for customers throughout the Yukon. For more information visit **www.yukonenergy.ca**



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