



A Trip to the Farm

Where are we going?

We're going to a farm.

Will we see pigs and horses? Can we pet the baby lambs?

No, not today, this farm doesn't have any animals.

Can we pick strawberries? Can we play hide-n-seek in the corn?

No, not today, this farm doesn't grow any fruits or vegetables.

Then what kind of farm is it?

It's a special kind of farm. Look up there on the hill. What do you see?

Windmills! Windmills everywhere! Hundreds of them!



Those are called wind turbines, not windmills. We're visiting a wind farm.

A what? A wind farm? I've never heard of that! Is this where they make wind? Is that what wind turbines do?

No, wind turbines don't make wind. They catch the wind. The sun makes the wind.

The sun? How can that be? It's far away. And what about night? The wind blows at night too, when the sun's gone away.

The sun doesn't blow; it makes wind in another way. Do you want me to tell you how?

Yes, but hurry, if you can. I want to climb up there to see the wind turbines.

Let's climb together. It will make more sense from the top of the hill. What do you see over there?

Wow! A lake! I'd like to swim there some time. But, tell me now, how does the sun make the wind?



When the sun shines, it warms up the land and the lake too. Which gets warmer, do you think?

The land, for sure. The lake would still be cool on the hottest day.

You're right. The lake stays cool. And the land gets hot. The air over the land gets hot too, and it rises into the sky.



Like a hot air balloon?

Like a hot air balloon. The air over the lake stays cool. The cool air rushes in to take the place of the hot air rising up to the sky. That's what makes the wind.

But what about at night? Why does the wind blow at night?

When the wind blows at night, it's because one place is cooling off faster than another. The cooler air moves in as the warmer air rises.

What do the wind turbines do?

The wind turbines are here to catch the wind. See the blades? The wind pushes against them and makes them turn.

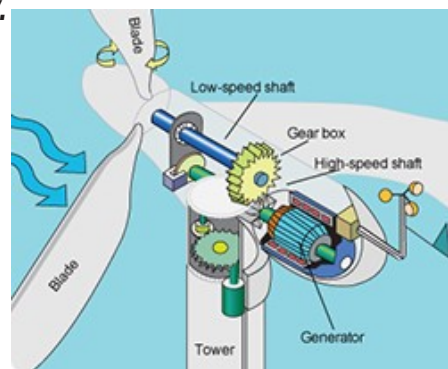


But why? Why catch the wind? All the blades are turning, but what do they do?

They make electricity—that's what they do. They make electricity so that we can have light and TVs and computers.

How do they make electricity?

Inside each wind turbine is a coil of wire—like a giant spool of thread. The blades of the wind turbine are connected to big magnets. When the wind blows, the blades turn and the magnets spin around the coil of wire. That makes electricity.



What happens when there isn't any wind?

Then the turbine blades stop spinning. The turbines stop making electricity. They can't make electricity all the time. Most wind turbines only work about 60 to 90% of the time.

But the wind is free and wind turbines don't pollute the air, do they?

Only with sound. When they are spinning very fast, they sometimes make a swooshing sound. Some people also think they look ugly.

Well, I like this farm. I think the wind turbines are awesome. Can we come back again sometime?

Yes, of course we can.



The Tale of Windy Wizard

Windy lived in a lighthouse with her father, who was a powerful wizard. Windy was his only child and he gave her whatever she wished. Windy loved the lighthouse, which stood on a high cliff above the ocean. She loved to play in the sun. She loved the seagulls flying in the sky. She loved to swim with the fish.

The only thing she didn't like was the wind. On the cliff, the wind blew all the time. If Windy had a picnic, the wind blew away her napkin. It carried her potato chips up to the seagulls. It blew sand into her drink.

One day, Windy's father gave her a new wizard hat. It was beautiful. Silver stars and moons glittered on it. Windy shouted for joy and ran outside to show the seagulls. Suddenly, a gust of wind grabbed the hat and blew it over the ocean. "Stop!" Windy cried, "Bring back my hat!" But the wind carried her hat away.

Windy ran inside. She was furious. "Father, Father, the wind took my new hat. I want you to make the wind stop forever!"

"Windy, I don't think you understand what you are asking," said her father.

"Yes, I do, Father! Make the wind go away! Do this if you love me!" And her father, the great wizard, could not deny his daughter. The next morning, it was cold and dark. There was no wind. Windy smiled, then shivered. Why was it so cold and dark? She ran to find her father.

"Thank you for stopping the wind, Father, but why is it so dark and cold? The sun should be up by now."

"I had to send the sun away to grant your wish, child. A dark, cold world is the price you must pay to stop the wind," explained the wizard.

"I love the sun, Father, I just wanted the wind to stop," cried Windy, "Please bring back the sun!"

"But it is the sun that makes the wind. The sun warms the land and the air over the land rises. The cool air over the ocean rushes in to take its place. To stop the wind, I had to send away the sun. That was your wish."

Windy looked at her father and grinned. "You did this to teach me a lesson, didn't you? I needed to know about the sun and the wind. I needed to learn to respect all of nature's energy. Now bring back the sun and the wind, and stop spoiling me!"



Wind Energy



Wind is moving air.
There will be wind as long
as the sun shines.



Wind Energy

TEACHER

Wind is moving air. We can use the energy in wind to do work. Early Egyptians used the wind to sail ships on the Nile River. People still use wind to move them in sailboats. In the Netherlands, people used windmills to grind wheat. The Pilgrims used windmills to grind corn, to pump water, and to run sawmills. Today, we use wind to make electricity.

The energy in wind comes from the sun. When the sun shines, it heats the Earth. Some parts of the Earth get hotter than others. An area where land and water meets is a good example. Land usually absorbs and releases energy more quickly than water. The air over the land gets hotter than the air over the water. The warm air rises and cooler air rushes in to take its place. The moving air is wind.

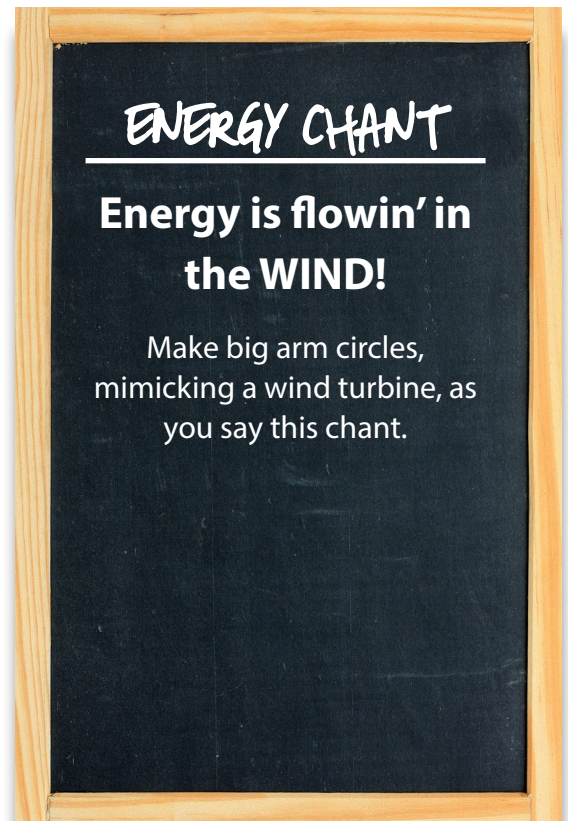
As long as the sun shines, there will be winds on the Earth. We will never run out of wind energy. It is a **renewable** energy source. It is also free, since no one can own the sun or the air.

Some places have more wind than others. Areas near the water usually have a lot of wind. Flat land and mountain passes are good places for the wind too. Today, we use big **wind turbines** to catch the wind. Sometimes, there are hundreds of wind turbines in one place. This is called a **wind farm**. Not all wind farms are on land; some countries have wind farms on the water. These are called **offshore wind farms**. The first offshore wind farm in the United States received approval in 2011. Construction on the Cape Wind Energy Project is expected to begin construction soon off the coast of Cape Cod, Massachusetts.

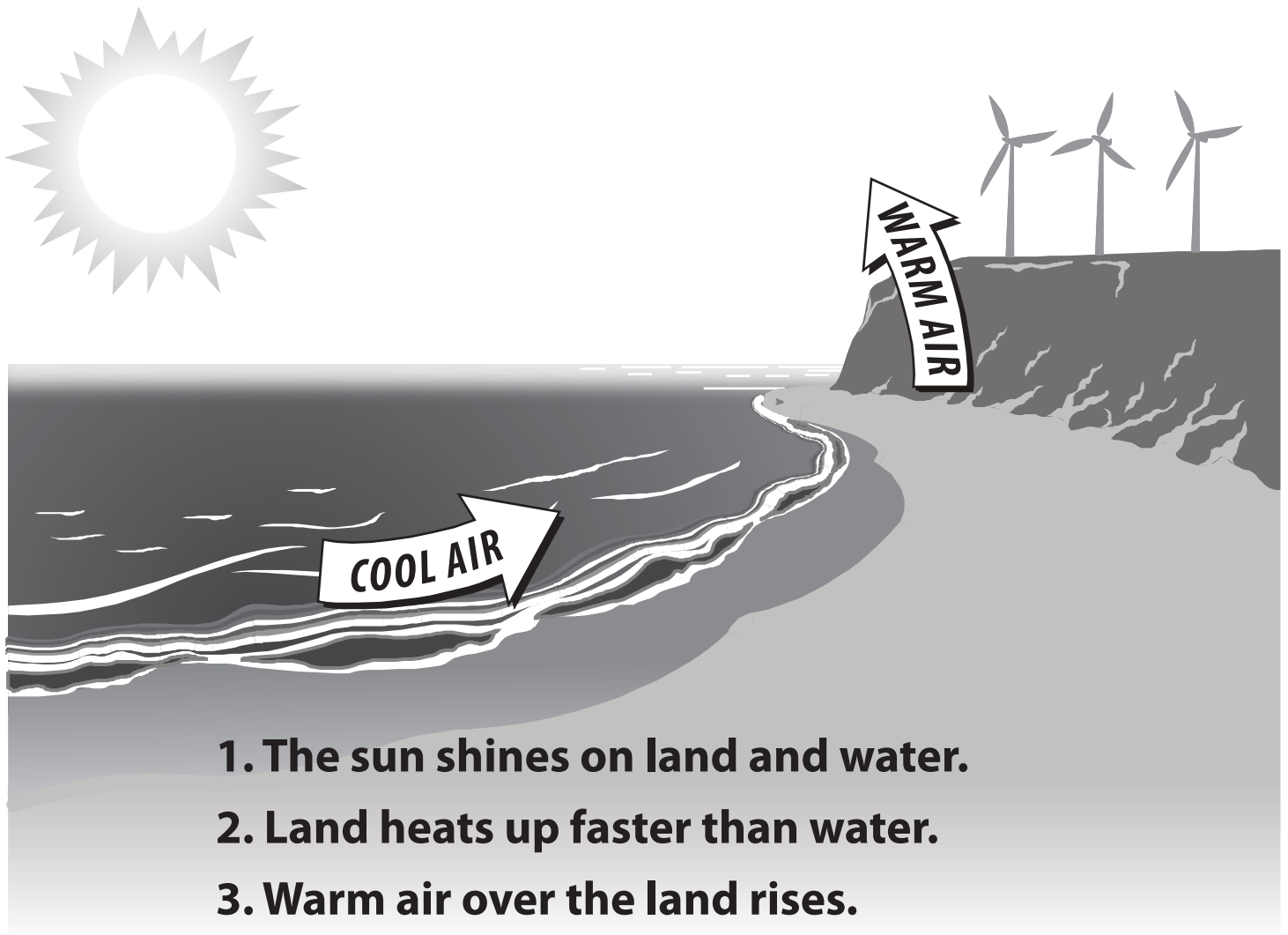
Many of the wind turbines on wind farms are very tall so they can catch the most wind. Some wind turbines are as tall as a 20-story building! Not all wind turbines are that big though. Some wind turbines might be only 30 feet tall. People can put these small turbines up in their backyards to generate electricity to use at home. Schools can put small wind turbines on their property to make electricity, too. Small wind turbines can even be put on sailboats so people have electricity when they are sailing on the water.

When the wind blows, it pushes against the blades of the wind turbines. The blades spin around. They turn a **generator** to make electricity. The wind turbines do not run all the time, though. Sometimes the wind does not blow at all. Sometimes the wind blows too hard. Most wind turbines operate 65 to 90 percent of the time.

Today, wind energy makes only a little of the electricity we use. Most of the big wind farms are in Texas, Iowa, and California. More wind turbines and wind farms are popping up all over the country.

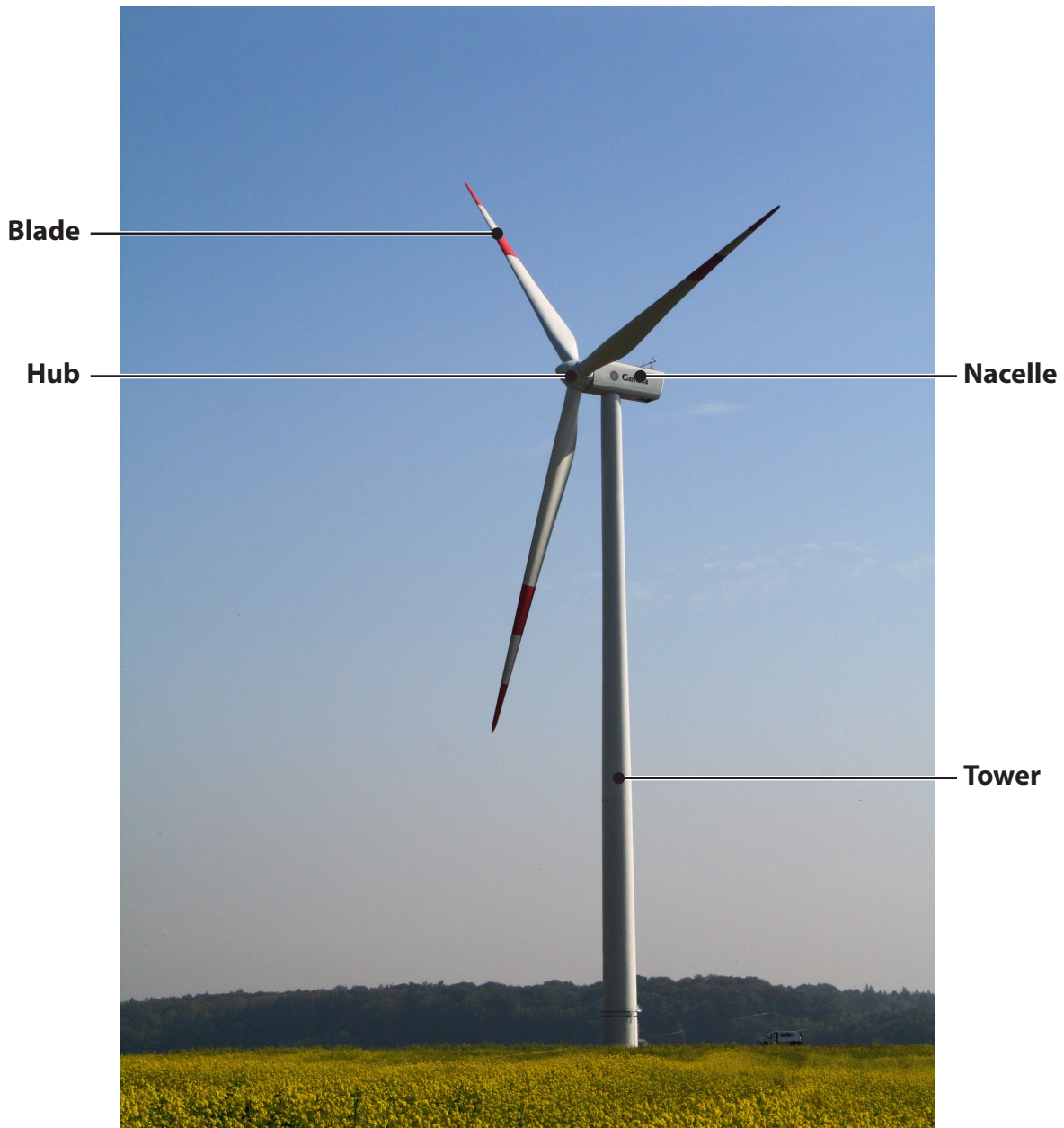


How Wind is Formed Where Water Meets Land



1. The sun shines on land and water.
2. Land heats up faster than water.
3. Warm air over the land rises.
4. Cool air over the water moves in.

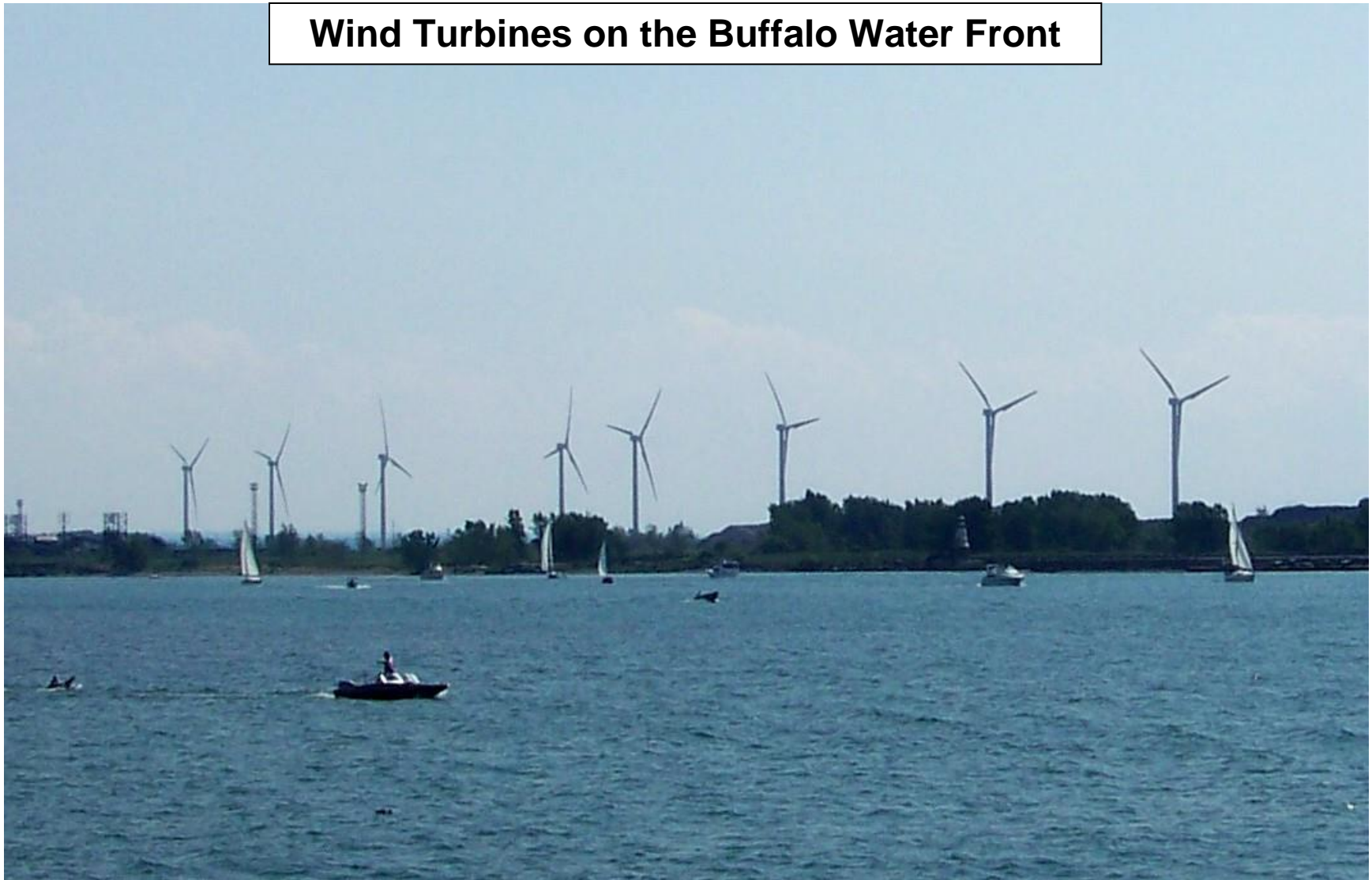
Wind Turbine



Wind turns the turbine blades, which spin magnets and wires inside the nacelle to generate electricity.

A wind turbine turns wind energy into electricity.

Wind Turbines on the Buffalo Water Front





Windmills

Used to Pump Water from lower levels of land out to sea.

If you come to Great Yarmouth by car and travel down the Acle Strait, the flat landscape is dotted with more than a dozen traditional windmills under the huge open sky as you head towards the sea.

This marshy wetland relies on drainage mills to pump water from marshes into dykes so that animals can still graze on the land in winter. Today these pumps are electric, but in the 1800's more than 240 drainage mills could be found all over the Broads. 74 mills survive today, although many are now in ruins. There were three very different types of drainage mill, a trestle mill, a hollow post mill and the more common tower mill.



Drainage mills had a fantail or tail pole with a mechanism to turn the sails into the wind and a mechanism to pump water, either a scoop wheel, plunger pump, or turbine. The mills transferred power from the turning sails through two sets of gears to an internal shaft. These shafts usually powered scoop wheels which scoop up collected water from low lying dykes and deposit it into higher level rivers which transported the water out to sea at Great Yarmouth. Later mills were often fitted with centrifugal pumps, known as turbines, which lifted water in a similar way to the effect of stirring a cup of tea very quickly.