EXPLORATION 1: WELCOME TO FELDHEIM AND WIND ENERGY

Watch the *video on Feldheim* as an introduction to the location you will be visiting.

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Field Trip to Feldheim

Boarding the tour bus in Berlin, you say farewell to the Graf family, who hosted your weekend homestay. Your group settles in for the hour and a half ride to Feldheim. Bypassing Potsdam, your bus route takes you through rural farmland, woodlands, and wetlands. Still tired from the weekend, you nod off, listening to the hum of the bus wheels and music on your smartphone. An hour passes. You wake to the crackling sound of a microphone being turned on. As you put your phone away, your tour guide, Peter, bids everyone good morning.

“I hope you all had a nice rest. If you look out on the left side of the bus, you’ll notice a common site in eastern Germany.” Through the window you spot a cluster of three wind turbines. The blades spin slowly and steadily in the light winds blowing from the east.

Peter continues, “In eastern Germany, winds come from the Caucasus region. These regional winds tend to be steady and dense—perfect for wind turbines. Onshore wind turbines produce about 10% of Germany’s electricity” (The Federal Foreign Office, n.d.).

“Are all the wind turbines in eastern Germany?” asks your classmate, Kendra.

“That’s a good question,” replies Peter. “Actually conditions in northern Germany are even more favorable for wind energy production, as this is the meeting point of easterly wind from the Caucasus and westerly winds from the Mediterranean Sea. Winds from the Baltic Sea and the North Atlantic Ocean are also strongest in the north. Offshore wind energy production is also possible along the northern coast.”

“Does that mean that all the wind turbines are in northern and eastern Germany?” you ask.

“Wind energy capture started in the east and north first, because there were good economic incentives, steady wind, and open space. However, new wind turbines with improved designs are being built in central and southern Germany.” Peter continues, “Mid 2020, there were 29,546 onshore wind turbines in Germany. In average locations, each 2- to 3-megawatt turbine can generate 3 million kilowatt hours of electricity annually. That’s equal to the electricity consumption of 1,000 households. Newer 5-megawatt wind turbines located in ideal conditions can meet the annual consumption needs of 6,000 households. Today you

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will be visiting Feldheim, a community that runs on 100% renewable energy" (Bowen, 2015).

"We will be arriving in Feldheim in a few minutes. Make sure you have your phone or camera to take pictures. We will be making our first stop at the education center."

The bus stops at the education center. Your tour guide and chaperones hand each student a snack, lunch, and a glass water bottle in a reusable cloth bag. Stretching, you look around and notice a large white metal structure. As you pass by the structure, you realize it is part of a wind turbine. Before entering the education center, each student receives a yellow, blue, or green name tag from a chaperone who explains the tag color is your group for the day. You enter the building and take a seat with the yellow group.

After all the groups are settled, Peter begins, "Welcome to Feldheim. You are in a district of the city of Treuenbrietzen in the state of Brandenburg. Feldheim is the first village in Germany to be 100% powered by renewable energy."

Peter introduces a member of the *Feldheim Energie GmbH & Co KG* (Limited) committee who welcomes your group and narrates a slideshow of facts about Feldheim. "The Feldheim Energie GmbH & Co KG (Limited) started in 1995 with four wind turbines. Each of the forty-nine landowners became partners by contributing 3,000 Euros. By law, only landholders can be partners. The few rental properties in Feldheim still rely on the national electricity grid for power. The residences of partners are connected to an underground smart grid constructed when the utility company refused access to the existing grid. All the electricity for partners is generated by wind power. The heating system is also underground and powered by bioenergy. All the electrical power from the *Selterhof Solar Farm* is sold to the national grid. So in addition to being a food farm community, Feldheim is also a power

farm community. I hope you enjoy your day here in Feldheim and that you will take some ideas back to your communities."

Peter introduces the guides who will be leading the education activities. "You will be exploring wind energy, solar energy, and bioenergy. Yellow group: You will start at wind energy, then go to solar energy, and end at bioenergy. Blue group: You will start at solar energy, then go to bioenergy, and end with wind energy. Green group: You will start at bioenergy, then go to wind energy, and end at solar energy. Make sure you take your daypack and lunch bags with you. Any questions?" Peter pauses, "No questions. Good. Yellow group: Go with Maja. Blue group: You are with Mohammed. Green group: Stay here with Priya."

WIND ENERGY

Phenomenon

By mid-2018, onshore wind turbines generated 15% of Germany's electricity, contributing to reduction of GHG emissions associated with electricity production.

Guiding Question

How could wind energy be harnessed to generate electricity for your community?

Overview

Maja leads your group into the entry room. "Please, everyone, make sure you have your bags. You will be wind turbine engineers today."

Walking outside, the yellow group gathers around the wind turbine structure you passed entering the education center. Maja hands out note organizers and pencils. "Technically, wind is a form of solar energy because air moves as the result of unequal heating of Earth's surfaces by the sun. Air in motion has kinetic energy and can exert a force. Wind turbines turn wind power into mechanical power and electrical power."

"On the way to the *Windpark* or, as you call it in the United States, wind farm, we will talk about how a modern wind turbine operates and special technology used in Feldheim. Please look at your note sheets; when we finish the walk, you should be able to name the components of a wind turbine and explain their function. At the *Windpark* we will look inside a wind turbine, read the current figures for wind speed and electricity production, as well as experience the size and aerodynamic features of the turbine."

Your group leaves the education center and begins walking toward the wind farm. The dirt road you follow cuts through a field. Along the road, tall grasses and wildflowers sway while tree leaves rustle in a cooling breeze.

"How much longer to the *Windpark*?" Kendra asks.

"Look, wind turbines," you point toward scattered white towers. Everyone stops to look and take pictures.

Maja calls for the group's attention. When the noise dies down. Maja smiles, "This is a good time to have a snack, drink some water, and talk about how the turbines generate electricity before we go inside a wind turbine."

"The *Windpark* started in 1995 with four wind turbines when the village decided to use our resources to become energy independent and reduce carbon dioxide emissions. Today we have fifty-five wind turbines and a large battery storage facility. The original turbines have been replaced with newer more efficient 3-megawatt turbines. One turbine produces enough electricity to power nine villages the size of Feldheim. The lithium ion battery storage building ensures continuous electricity flow. The battery storage building is an important innovation for ensuring continuous power. We sell the excess electricity to the national electrical grid. So the power from Feldheim's wind reaches beyond our village."

"What natural resources do you think make Feldheim a successful location for a *Windpark*?" Maja asks.

Students call out: "Wind." "Land." "Money."

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"Well, yes, wind and land would count as natural resources. Money is economic. On the benefit side, we also save money on our electricity and heating by selling the excess power. What about environmental and social benefits?"

Kendra raises her hand. "Less greenhouse gases."

Maja nods her head, "Yes. Reducing carbon dioxide is good for the environment and for human health. The *Windpark*, solar farm, and bioenergy plant also created new jobs. That could be both a social and economic benefit. Please take out your organizers and find a partner."

Looking at the diagram, you see the blades and hub make a rotor attached to a shaft. The shaft connects to a generator. The generator connects to battery storage. Battery storage connects to an electrical power grid.

"Let's analyze this like a story. How does the story begin?" Maja asks.

You think for a moment while watching the three blades of a wind turbine slowly rotate in the light wind. You add your observation on the diagram as a note under blades. You and Kendra analyze the diagram, writing down your ideas and questions.

How Does a Wind Turbine Work?

Working with a partner, analyze the wind turbine animation *How Does a Wind Turbine Work?*, on energy.gov. Explain how wind power converts to mechanical power and how mechanical power becomes electrical power.

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