Mona Goudarzi does research to find out how wind turbines can be made taller and lighter.

Mona Goudarzi, *Mechanical Engineer*

What would have happened if Mona Goudarzi's brothers hadn't played with their little sister?

Mona Goudarzi grew up in Iran. Even as a little girl, she was very interested in a certain technical device: the television. For example, she wondered how the people, animals and objects got inside the TV. Fortunately, she had two older brothers who were also interested in technology and liked to tinker with remote-controlled cars and small home-made robots. Mona was often there when her big brothers did their technical experiments, and she closely watched what they were doing. They often let her help them build their devices.

Mona's two brothers told her a lot about technology and tried to show their little sister how images are transmitted on TV. She didn't understand everything right away, but she did learn something very important: It's good to think about something for such a long time that in the end you really understand it.

Mona Goudarzi came to Germany when she was 16 years old. Her teachers quickly saw that she enjoyed thinking about technical problems, and they advised her to choose a technical profession. Mona studied at a university and became a mechanical engineer. After she received her engineering degree, she joined a research group that works with wind turbines at the Institute for Integrated Production (IPH) in Hanover.

How does a wind turbine work?

A wind turbine converts the energy of the wind into electricity. To do that, the wind turns the rotor blades – the "wings" – of the turbine. The rotor blades are connected to a dynamo called a "generator". The generator produces electricity, and this electricity flows through thick cables into the power grid. A wind turbine basically works like a giant bicycle dynamo. The bicycle dynamo converts muscle power into electricity for the bicycle lamp, and the wind turbine converts wind power into electricity for households, factories and many other places.

To make sure everything works smoothly, a control computer regulates all the processes in the wind

The wind blowing up high is stronger than the wind blowing near the earth's surface. (©fotolia.com/Günter Menzl)

turbine. It is located in the nacelle (machine pod), at the foot of the turbine, or outside the tower. For example, wind measuring devices on the wind turbine send data about the current wind strength and wind direction to the control computer. The control computer then sends information to the yaw motors, which turn the entire nacelle so that the rotors are facing into the wind. The straighter the wind turbine is facing into the wind, the more electricity it produces.

A device that measures wind speed is called an anemometer. It consists of small bowls that the wind turns in a circle, and it is attached to the nacelle. When the wind is very strong, 90 kilometres per hour or more, the computer turns the wind turbine off. Otherwise the rotors might break.

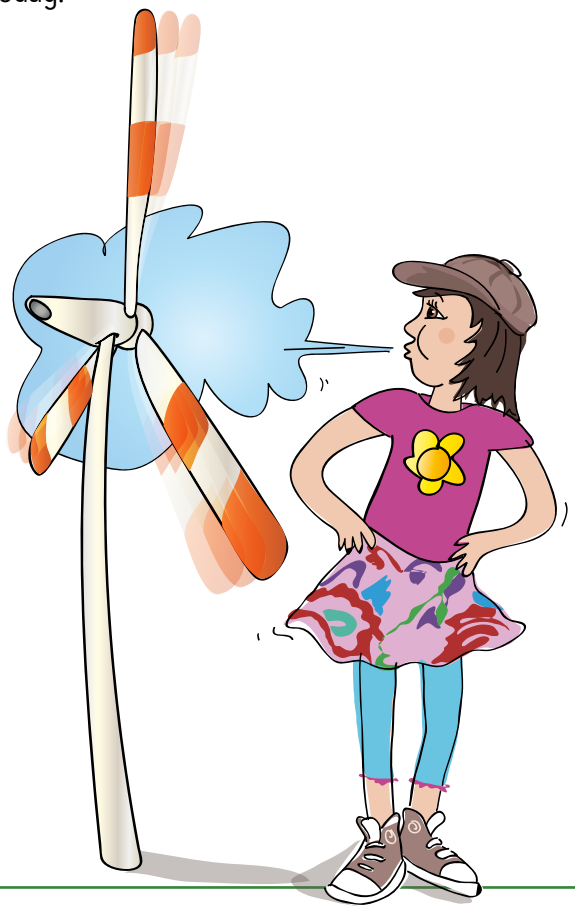
Up high, the winds are strong

The basic rule for wind turbines is that the rotor blades should be turning as high as possible above the ground. That's because the higher up you go the stronger the wind gets, and that means the rotor blades can turn faster and produce more electricity. Today wind turbines can reach up into the sky as high as 180 metres. It is not possible to build them any taller at the moment. That's because the taller the towers are, the stronger they need to be in order to securely support the nacelle and the rotor blades even in a strong wind. At some point this makes the towers so heavy that they could collapse under their own weight.

Lightweight construction is needed

It may be possible to build wind turbines higher in the future, but only if the towers and the rotors can be made strong and light. Mona Goudarzi is carrying out research to find out which materials and which kinds of construction can be used to do that. For example, so far the towers have been made of thick rings of steel or concrete that are placed on top of one another. But new kinds of construction material are also promising. With these materials, the tower is made of an inside steel band and an outside steel band, with another material filling the space between them. This material could look like a honeycomb, because the six-cornered shape of a honeycomb is especially strong but also very light.

Mona Goudarzi and her team must do a lot more research and tinkering before this kind of new wind turbine can be built. If they succeed, in a few years we may have much higher wind turbines than we do today.



Now it's your turn!

1 Wind turbines near you

Look for a wind turbine near you. Visit the wind turbine during a class trip and look at it from up close. You may be able to find a specialist who can explain to you how the wind turbine works. Find out about wind turbines from the companies that sell electricity where you live. Take the information you have learned and use it to make posters about the topic of wind turbines.

2 Building a device to measure wind speed (anemometer)

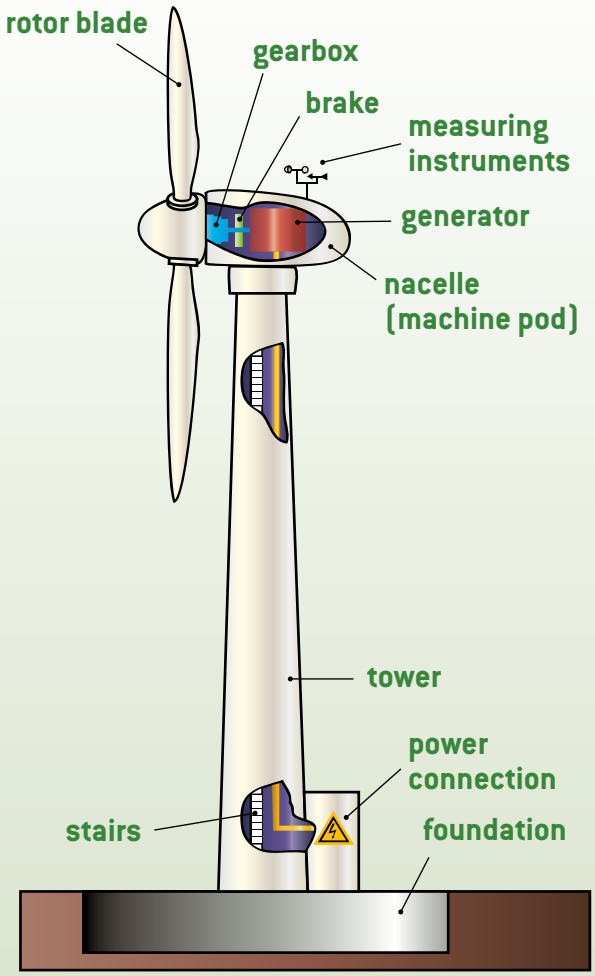
Look for a picture of an anemometer in books or on the Internet. Look at the device carefully and think about how you can build such a device yourself. Form small groups and decide on a design for your anemometer, then gather the materials you need. Make sketches of your anemometer and build it. Write a set of instructions as you go along. Test your anemometer and present it to the other groups. Talk about the advantages and disadvantages of your different designs.

3 Discussing wind turbines

Wind turbines are enormous structures that can't be missed. Some people think we should build fewer wind turbines so that we can stop spoiling our landscapes. Form small groups that look for reasons in favour of wind turbines (pro) or against them (contra). Think about how you want to present your arguments, and tell the others about your points of view. Discuss this topic in your class.

4 A construction made of paper

Form small groups and think about how you can make a structure out of paper. It should be tall and strong, but also light. It doesn't necessarily have to be shaped like a pipe. There are also wind power plants that are held up by lattice towers (made of girders). Look for pictures of such towers. Discuss in your classroom how you can find out which tower is the best one. Work together to make rules for the best paper construction. Use only paper and glue.



Mona Goudarzi – Mechanical Engineer

Mona Goudarzi grew up in Iran.
Even as a little girl, she was very interested
in technical devices.
For example, she wanted to know how animals and people got
inside the television.
Her two older brothers told her a lot about technology.
In this way she learned something very important:
it's good to think about something for a long time
until you really understand it.

Mona Goudarzi came to Germany when she was 16 years old.
Her teachers saw that she enjoyed thinking about technology.
They advised her to choose a profession in this area.
Mona Goudarzi studied mechanical engineering.
She joined a research group that worked with wind turbines.

Wind turbines produce electricity.
Up high, the wind is stronger.
The rotor blades turn faster.
More electricity is produced.
Today wind turbines are about 180 metres high.

The material has to be very light.
But the wind turbine also has to be stable enough.
The tower has to support the nacelle and the rotor blades even if the wind is strong.
Mona Goudarzi is doing research to find out how wind turbines
can be made even higher and more stable.

Imprint

Taken from
Lantern Moon and Hot Ears – Language promotion in primary school teaching through inquiry-based learning using biographies
available in English and German
www.science-on-stage.eu/lantern_moon

Published by
Science on Stage Deutschland e.V.
Poststraße 4/5
10178 Berlin · Germany

Translation
TransForm Gesellschaft für Sprachen- und Mediendienste mbH
www.transformcologne.de

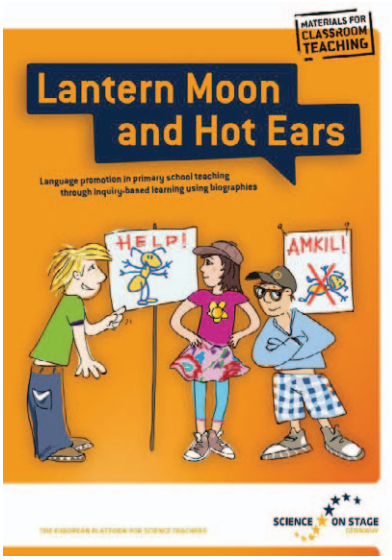
Credits
The authors have checked all aspects of copyright for the images and texts used in this publication to the best of their knowledge.

Design
WEBERSUPIRAN.berlin

Illustration
Rupert Tacke
info@ruperttacke.de

Please order from
www.science-on-stage.de
info@science-on-stage.de

First edition published in 2015



Science on Stage – The European Network for Science Teachers

... is a network of and for science, technology, engineering and mathematics (STEM) teachers of all school levels.
... provides a European platform for the exchange of teaching ideas.
... highlights the importance of science and technology in schools and among the public.

The main supporter of Science on Stage is the Federation of German Employers' Associations in the Metal and Electrical Engineering Industries (GESAMTMETALL) with its initiative think ING.

Join in - find your country on
WWW.SCIENCE-ON-STAGE.EU

www.facebook.com/scienceonstageeurope
www.twitter.com/ScienceOnStage

Subscribe for our newsletter:
www.science-on-stage.eu/newsletter

SCIENCE ON STAGE GERMANY
THE EUROPEAN NETWORK FOR SCIENCE TEACHERS

MAIN SUPPORTER OF SCIENCE ON STAGE GERMANY
think ING.
Die Initiative für Ingenieurnachwuchs

IN COOPERATION WITH
jugend forscht