WIND POWER ENERGY

- OBJECTIF: This lessons aims at discovering wind electricity production. Our tasks will consists in

  - explaining how a wind turbine works

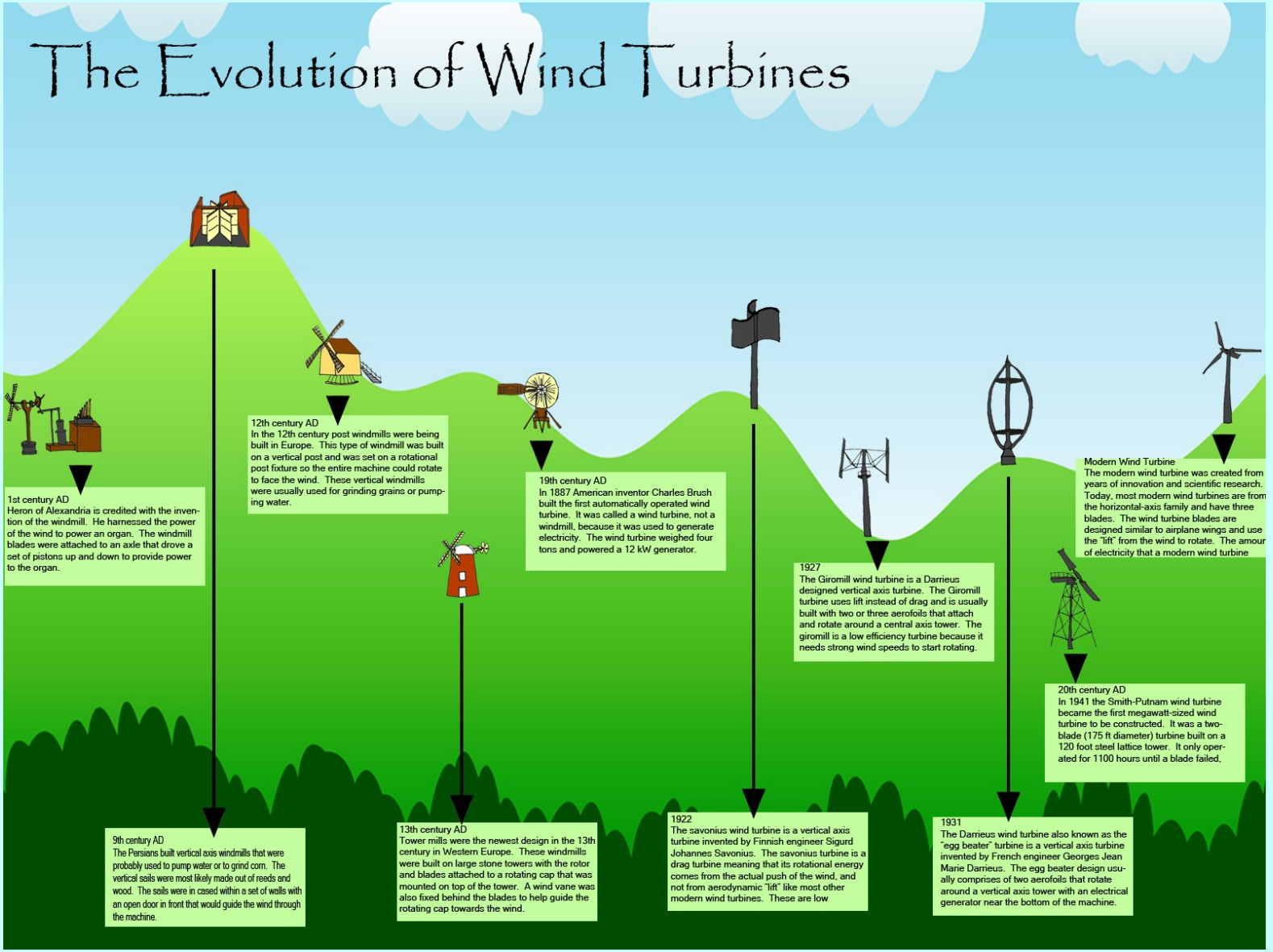
  - observing how wind farms are installed

  - finding the differences between on-shore and off-shore turbines

  - and finally distinguishing different types of wind turbines (vertical or horizontal process)

  Final task: with the help of the following scheme , compare advantages and disadvantages of two different types of wind turbine (comparison between horizontal axis wind turbine and vertical axis wind turbine)

An old renewed means to produce energy



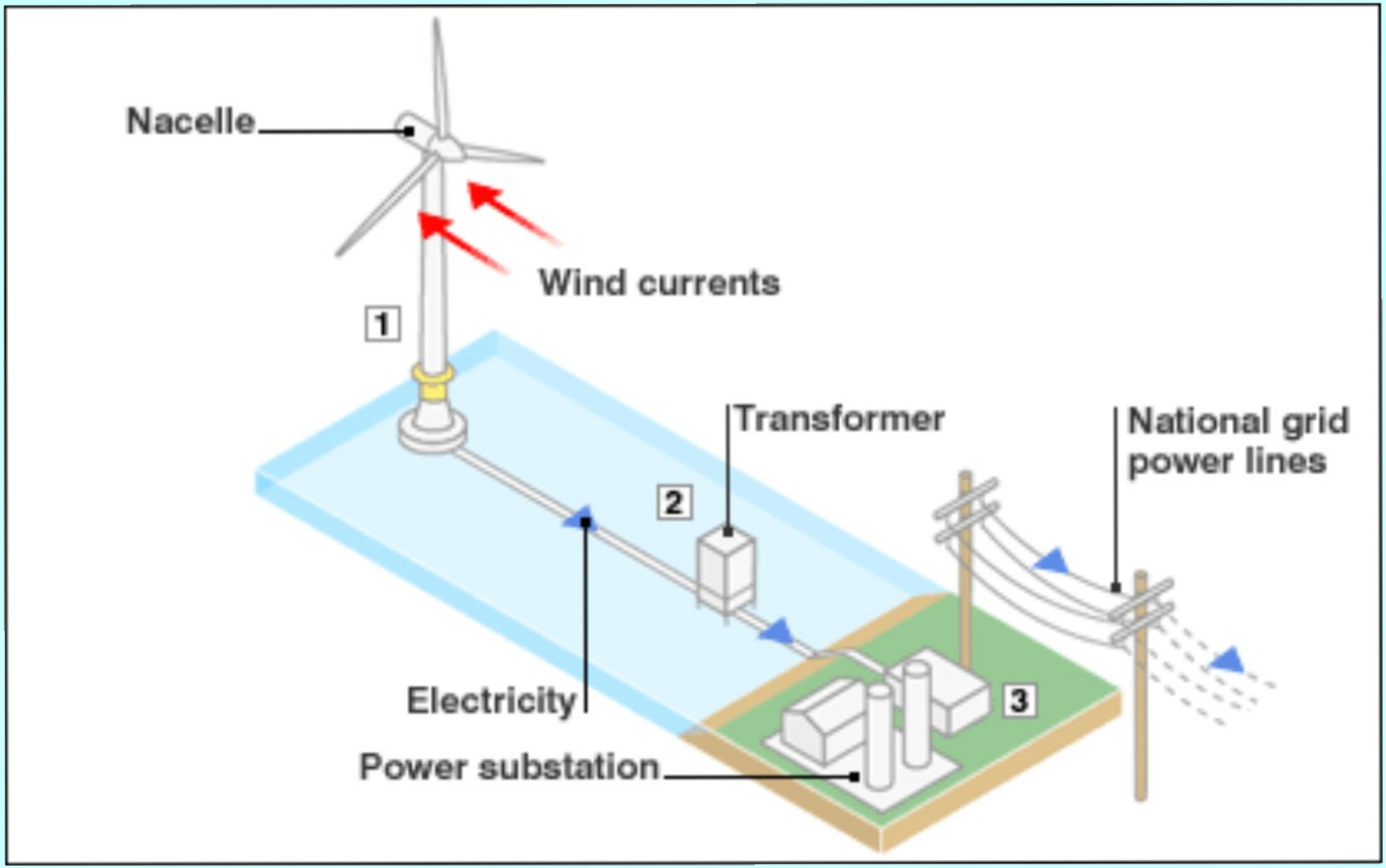
Watch the video now!

https://www.youtube.com/watch?v=SQpbTTGe_gk

SEE HOW IT WORKS

Wind is blowing across a turbine blade. And there is more pressure on one side of the blade than on the other. This causes a magnetism of all three connected blades to turn. This rotation pushes on series on spinning parts inside the body of the turbine which in turn spins the generator producing electricity.

GLOBAL WIND POWER PLANT SCHEME



Act n°1: VOCABULARY ACTIVITY: find the definition of the following words according to their context of use

- Blade
- Spinning part
- Magnetism
- Turbine
- Generator
- Power substation
- Grid
- Transformer

Act n°2: inside a windmill: vocabulary

Typical wind turbine components :

1-Foundation,

2-Connection to the electric grid,

3-Tower,

4-Access ladder,

5-Wind orientation control (Yaw control),

6-Nacelle,

7-Generator,

8-Anemometer,

9-Electric or Mechanical Brake,

10-Gearbox,

11-Rotor blade,

12-Blade pitch control,

13-Rotor hub

Act n°2: inside a windmill: vocabulary according to their definitions, find the translations of the following words

Typical wind turbine components :

1-Foundation: place made of concrete where the mast is set

2-Connection to the electric grid: device between the wind mill and the grid

3-Tower: the mast which carries the nacelle

4-Access ladder: a device which helps people to climb up the nacelle

5-Wind orientation control (Yaw control): a device which puts the blades right in facing the wind

6-Nacelle: upon the mast, place which carries the blades and the devices of energy production

7-Generator: transforms the energy given by the blades in electricity

8-Anemometer: measures the wind speed

9-Electric or Mechanical Brake: device devoted to slow down the mechanism

10-Gearbox: increases rotational speed from a low-speed rotor to a higher speed electrical generator

11-Rotor blade: there are multiple rotor blades attached to a hub. The rotor converts the wind energy into a rotation

12-Blade pitch control: regulate the blade speed in order to avoid too high speed rotation

13-Rotor hub: centre of the rotor to which the rotor blades are attached. The hub directs the energy from the rotor blades on to the generator

Act n°2: inside a windmill: vocabulary

Typical wind turbine components :

1-Foundation

2-Connection to the electric grid

3-Tower

4-Access ladder

5-Wind orientation control (Yaw control),

6-Nacelle

7-Generator

8-Anemometer

9-Electric or Mechanical Brake

10-Gearbox

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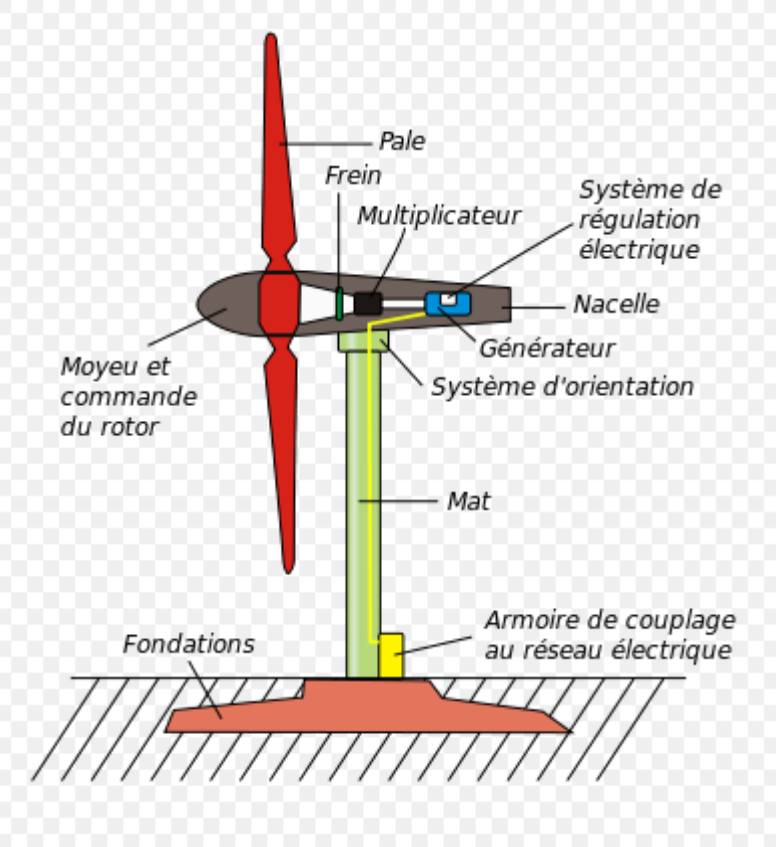
12-Blade pitch control

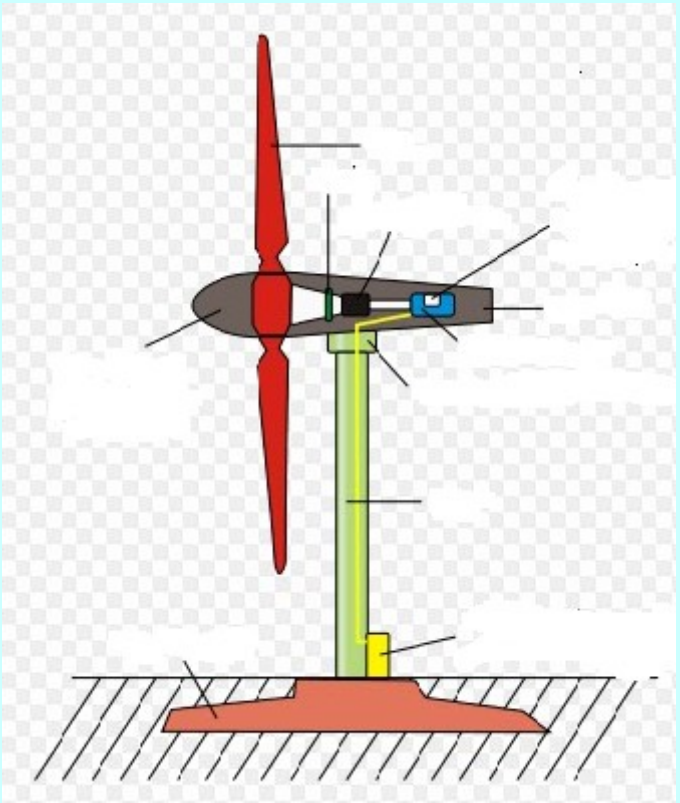
13-Rotor hub

- Composants d'une éolienne typique
- Fondation
- Connection au réseau
- Tour
- Échelle d'accés
- Système d'orientation
- Nacelle
- Générateur
- Anémomêtre
- Frein électrique ou mécanique
- Multiplicateur
- Pâle
- Commande du rotor
- Moyeu de rotor

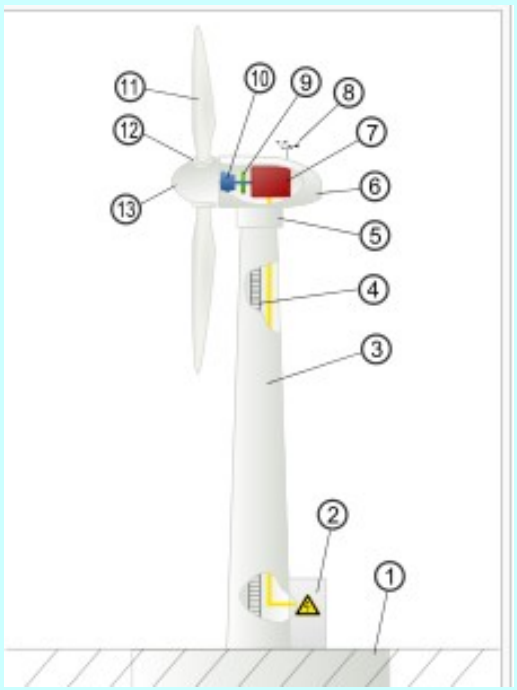
A windmill explanation scheme



Put the words at the right place



And now in English



Typical wind turbine components :
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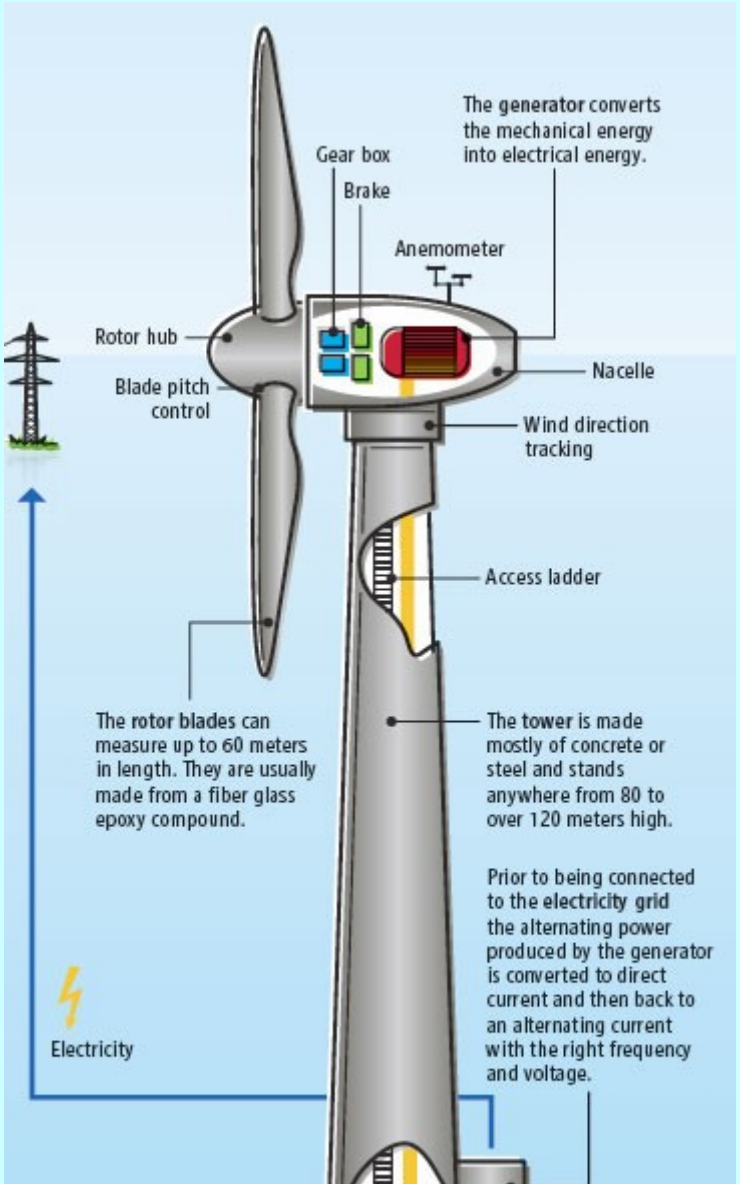
Scheme of answers (bis)



Tâche intermédiaire: With the help of the scheme, describe how it finally works technically

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- Large rotor blades are necessary to intercept the maximum air stream but these give rise to very high tip speeds. The tip speeds however must be limited, mainly because of unacceptable noise levels, resulting in very low rotation speeds which may be as low as 10 to 20 rotations per minute for large wind turbines. The operating speed of the generator is however is much higher, typically 1200 rpm, determined by the number of its magnetic pole pairs and the frequency of the grid electrical supply. Consequently a gearbox must be used to increase the shaft speed to drive the generator at the fixed synchronous speed corresponding to the grid frequency.
- Note that a "synchronous generator" is one whose electrical output frequency is synchronised to its shaft speed. It is not necessarily synchronised to the grid frequency, although that is usually an objective and extra, external controls are necessary to achieve this.

REASONS TO USE IT

Because wind is always blowing somewhere across the surface of the earth, it's considered a renewable resource and because the only thing required to turn a wind turbine is moving air, wind farms emit no greenhouse gases.

However even though it's clean and abundant, there are a number of reasons why we still not use wind power more widely.

Act n° fill in the following grid

MAIN CAUSE TO THINK THAT WIND POWER IS A RENEWABLE ENERGY	
ONLY NEEDED THING TO A WIND TURBINE	
RATE OF GREENHOUSE EMISSIONS	
MAIN ADVANTAGES OF WIND POWER	

Act n° fill in the following grid

MAIN CAUSE TO THINK THAT WIND POWER IS A RENEWABLE ENERGY	Wind is always blowing somewhere on th earth
ONLY NEEDED THING TO A WIND TURBINE	A moving air
RATE OF GREENHOUSE EMISSIONS	0 no gas emissions implies no greenhouse effect
MAIN ADVANTAGES OF WIND POWER	Clean and abundant

DISADVANTAGES OF THIS TECHNIQUE

The first and perhaps the most important is that the wind doesn’t always blow. At least, not always at the same spot. And technologies for storing a lot of electricity for later use are currently very expensive.

Another problem is location. It doesn't make sense to put wind farms just anywhere. The best sites are open windy places which are often far from city centres where energy demand is the greatest. So more transmission lines are necessary to move electricity to where it's needed.

Finally, where wind farms are relatively cheap to operate but they cost a lot to build especially in comparison to existing coal or natural gas power plants.

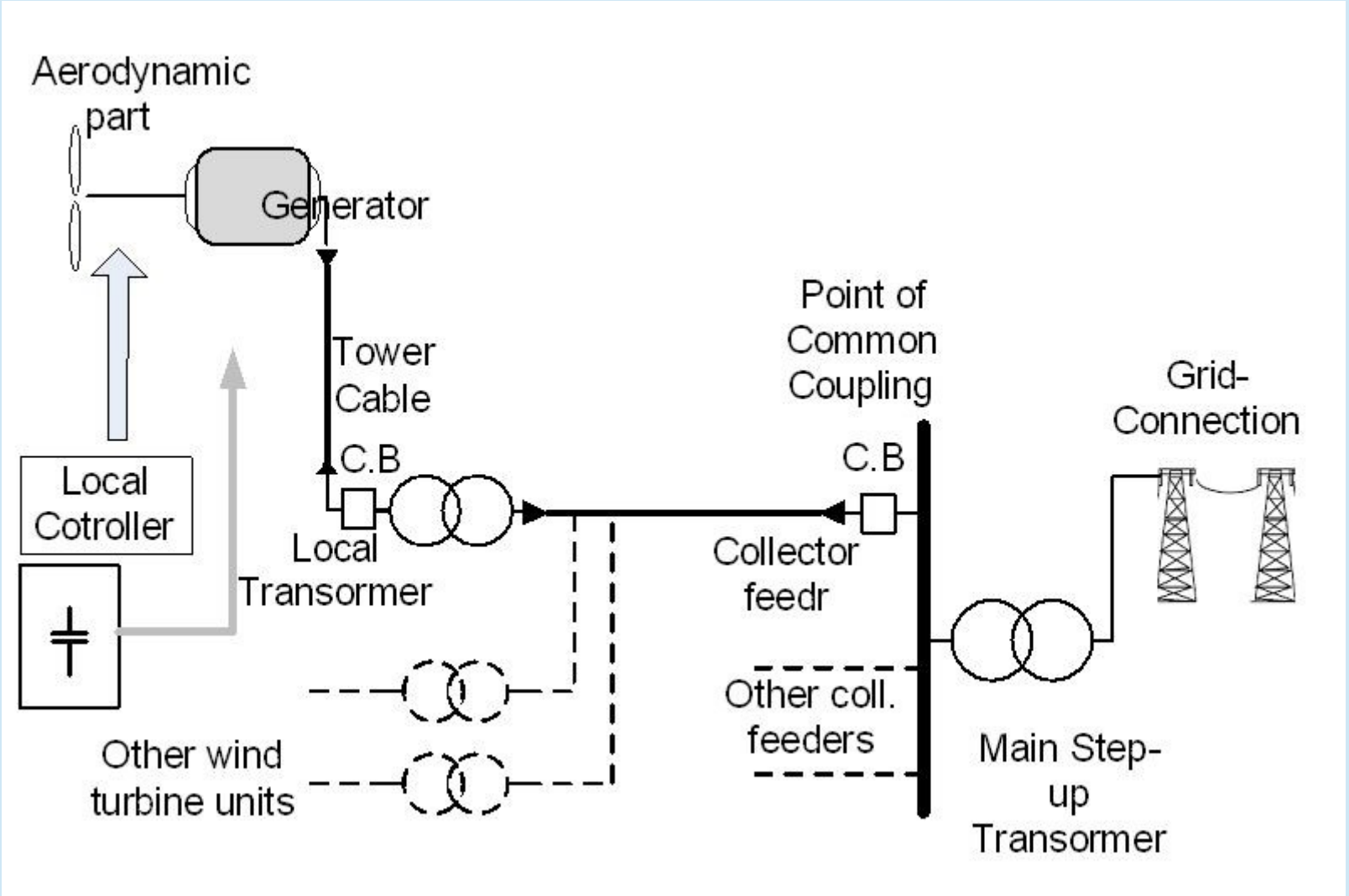
Fill the following grid according to the text

DISADVANTAGES OF A WIND POWER PRODUCTION	
NEEDS TO USE WIND POWER	
FINANCIAL ASPECTS	

Answers

DISADVANTAGES OF A WIND POWER PRODUCTION	- wind doesn't always blow - wind doesn't always blow at the same spot - electricity storage - location (far from cities) - costs of building wind farms
NEEDS TO USE WIND POWER	- long power lines - expensive installations
FINANCIAL ASPECTS	- costly installations - more expensive than traditional power plants

A wind power plant or wind farm



Act n° Explain how a wind farm works observing the former drawing in few sentences

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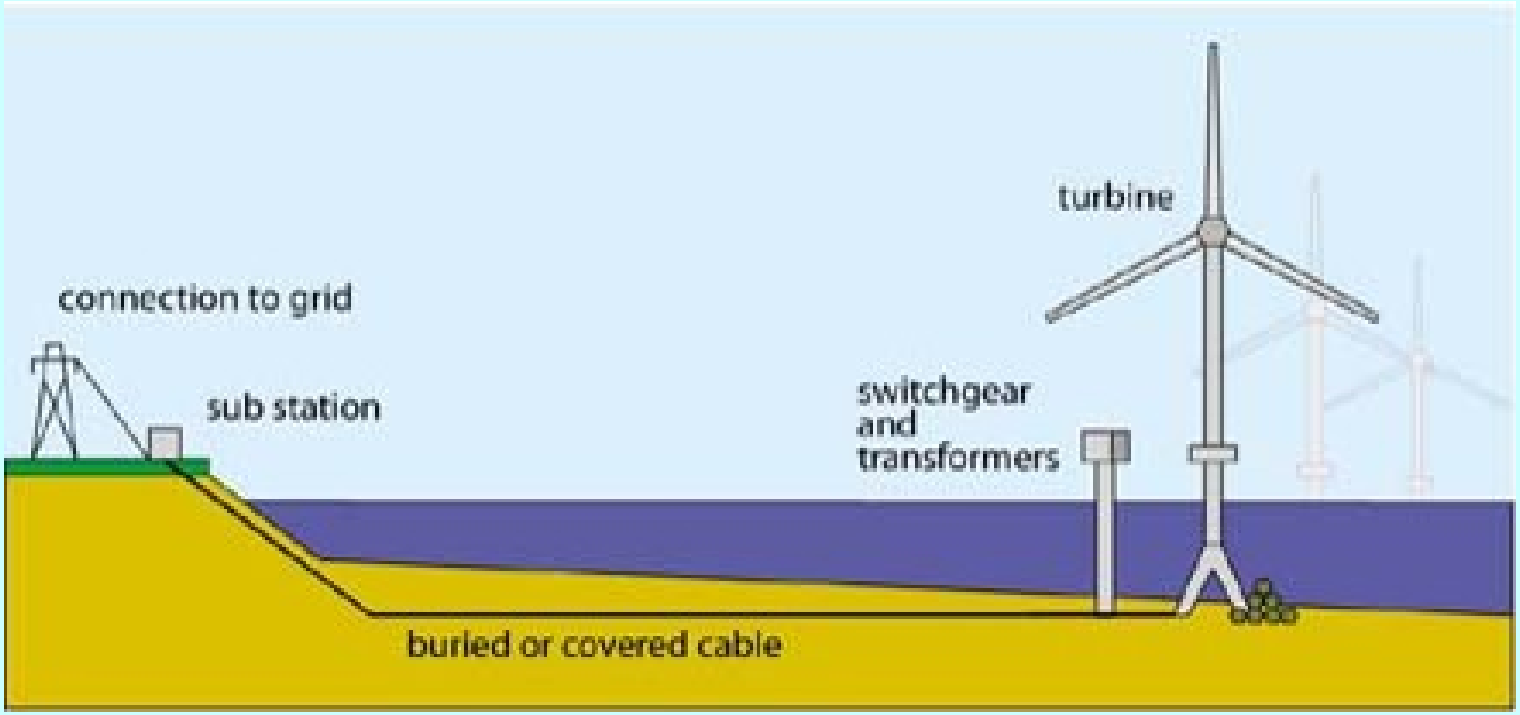
- Numerous wind turbines are gathered and installed into arrays* at one site to build a wind farm of the desired power production capacity. The turbines may be grouped into arrays, feeding power to a utility*, with its own transformers, transmission lines and substations.

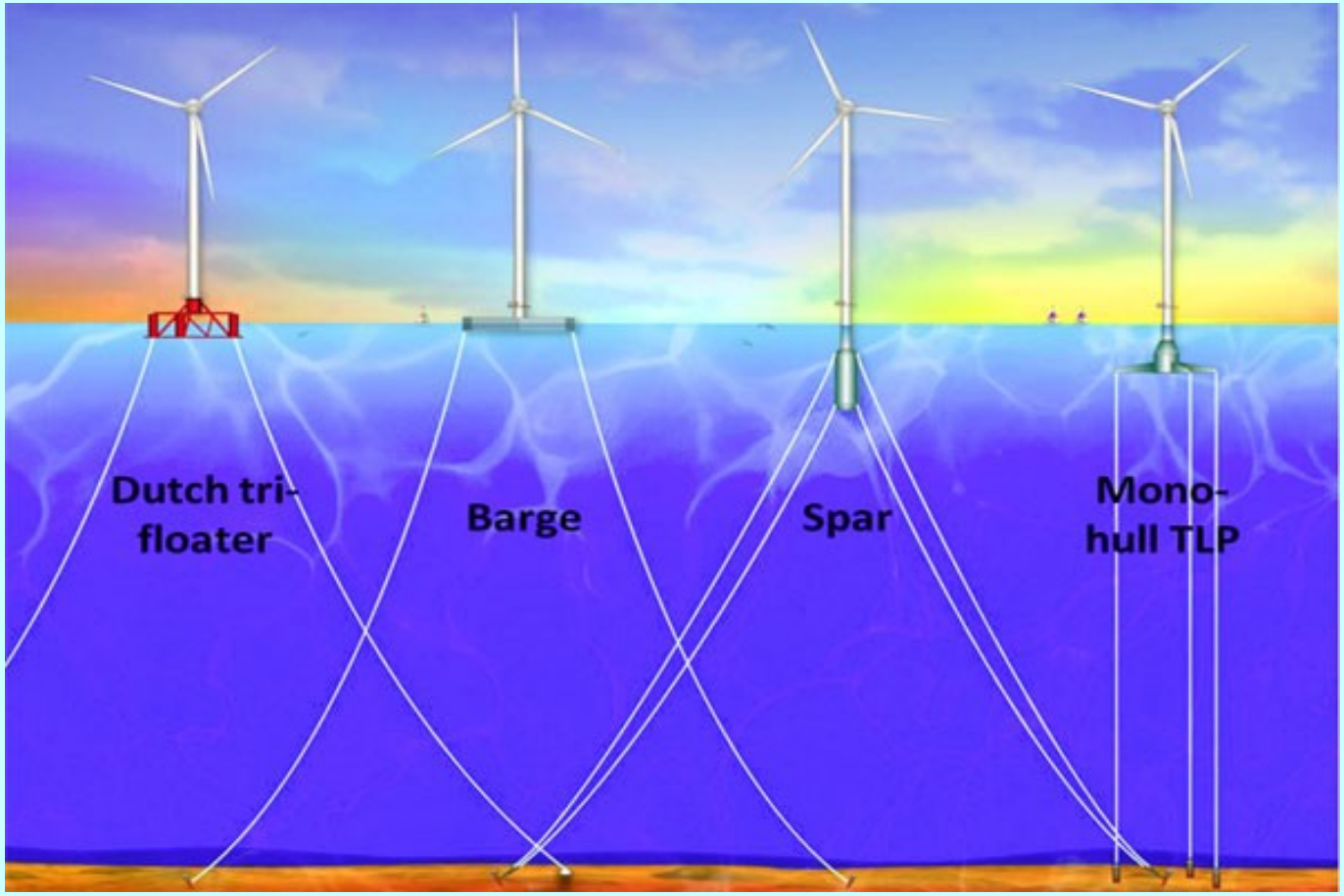
  *arrays: un alignement

  *utility: service public

Off-shores turbine scheme



Four types of off-shore wind turbine



Intermediate task:Explain the differences between an on-shore wind turbine an an off-shore turbine

Explain the differences between an on-shore wind turbine an an off-shore turbine

- Offshore wind farms are composed of windmills which are set in the sea. They are put on sea beds. There is no nacelle as the gears and the transformers are partly in a nearby box upon a second mast. A buried or covered cable runs under the sea from this installation and goes to the substation* on the shore. From there start the grid power lines which provide electricity.
- We can notice that different turbine installations exists according to the way they are fixed on the seabed.

*place where high-voltage electricity from power plants is converted to lower-voltage electricity for homes or factories.

Summary

- An offshore wind farm is a group of wind turbines located in the sea at a single point and generating electricity.
- It works the same way as an onshore wind farm. Its location in the sea allows it to use the wind in a marine context
- Their installation is sometimes controversial
- There are three different types of offshore wind turbine foundations:

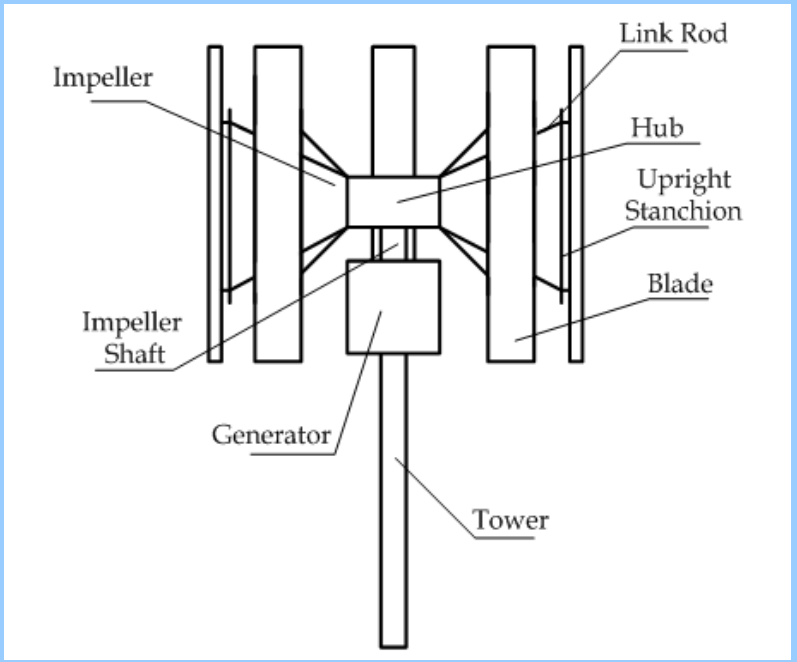
  -The Gravity Based Structure: structure held on the seabed by gravity. It generally consists of structure of reinforced concrete filled with ballast.

  -The mono-pile foundation: foundation constituted of a steel pile of large diameter down to several meters into the seabed.

  -The jacket foundation: foundation constituted of a tubular steel truss structure based on four piles anchored in the seabed

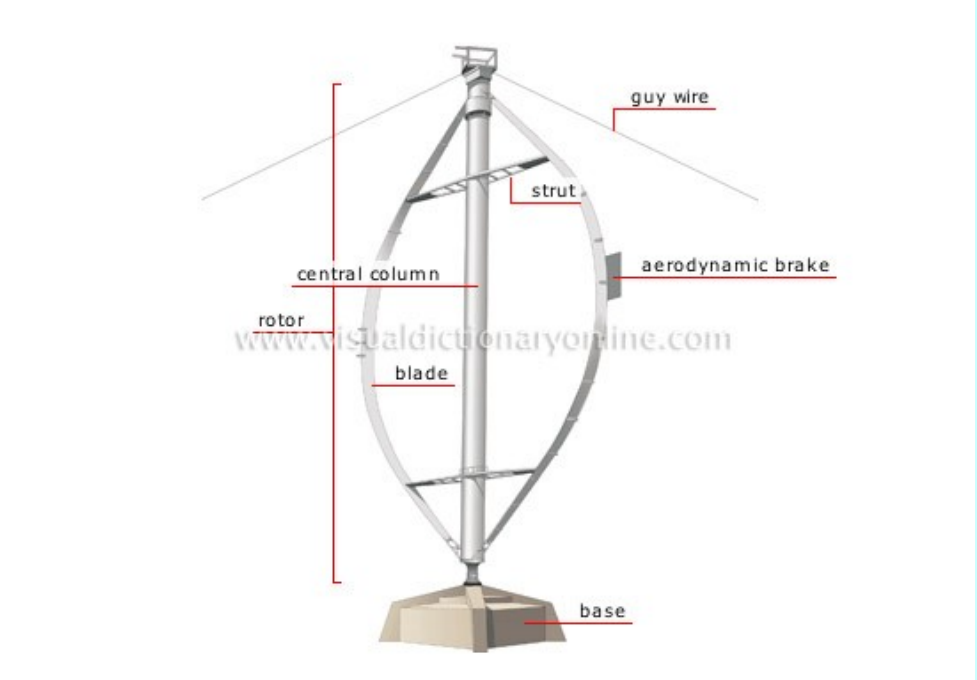
Some other kinds of wind turbine:

- Impeller: compressor
- Upright stanchion:étançon droit



The main difference is the way to collect wind

Some other kinds of wind turbine



And some other configurations exist: it's almost unlimited

Take a look at the original websites

- http://www.tradekorea.com/product/detail/P478026/Vertical-Axis-Wind-Turbine-(VAWT-VA-VP-Series).html
- http://www.turbinesinfo.com/types-of-wind-turbines/
- http://freeliff.com/of-savonius-wind-turbine/

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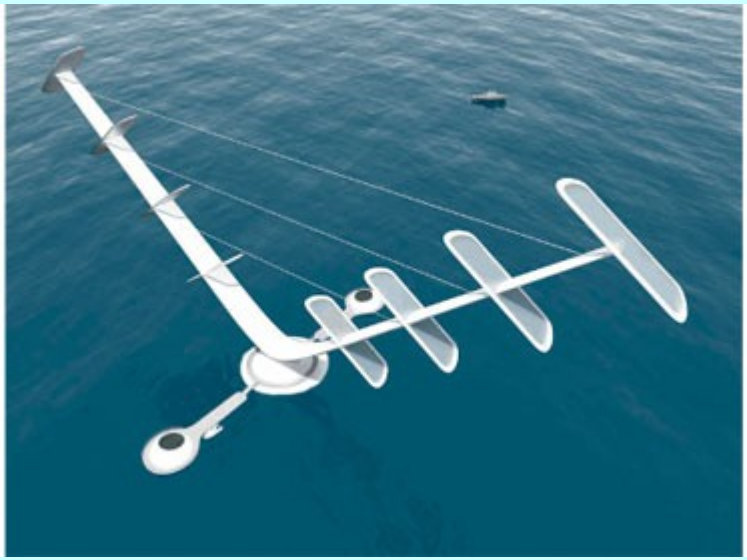


Act n° forms groups of four persons and chose a wind turbine in order to describe how it works

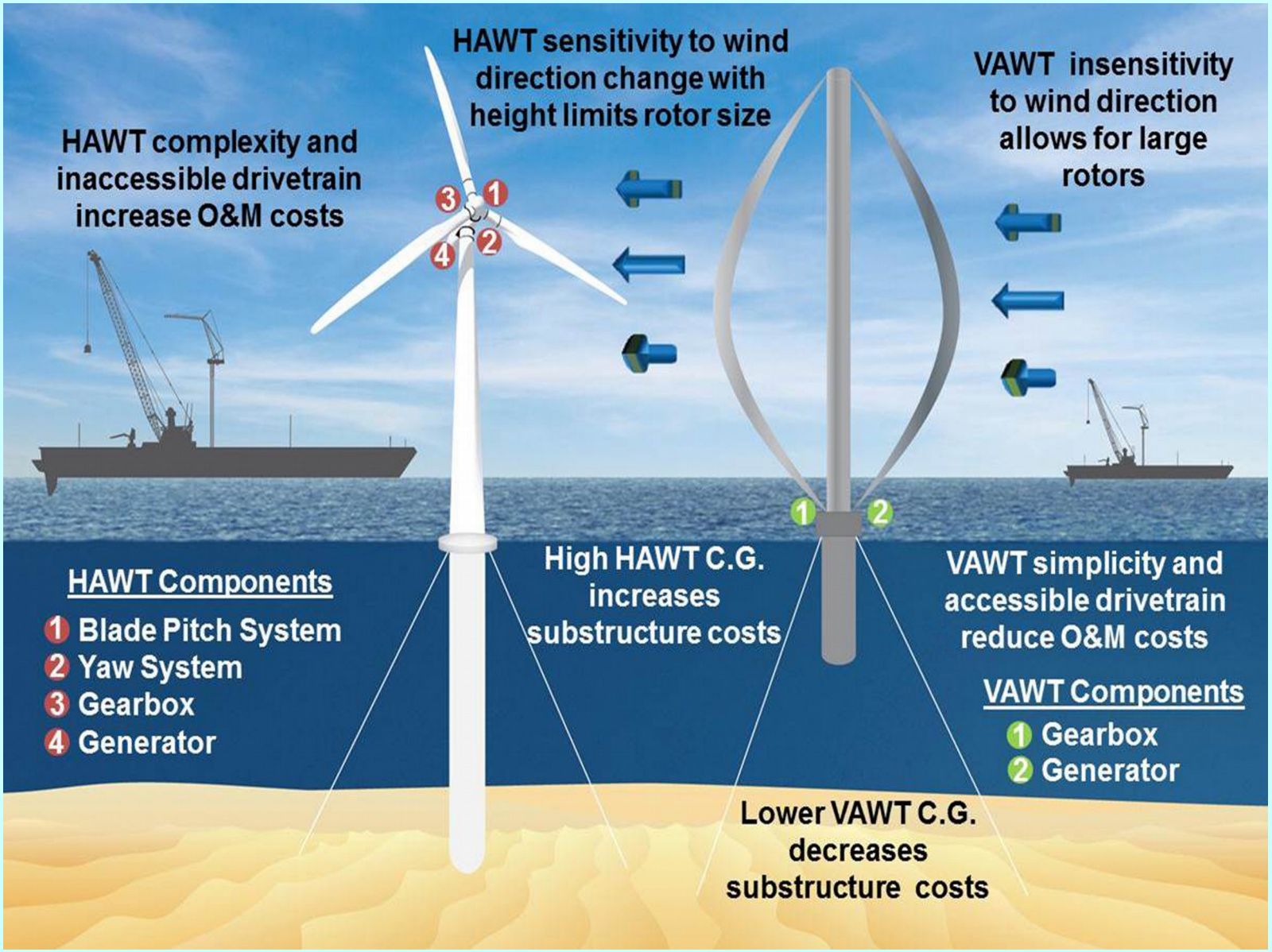
http://news.discovery.com/tech/alternative-power-sources/top-wacky-wind-turbines-photos-130408.htm

http://www.whirlopedia.com/index.php/vertical-axis-wind-turbines

http://www.whirlopedia.com/index.php/cylindrical-conical-wind-turbines/

- http://www.theguardian.com/environment/2010/feb/22/aerogenerator-wind-turbine

Tâche finale: with the help of the following scheme , compare advantages and disadvantages of two different types of windmill



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