6 THE SECONDARY SECTOR. INDUSTRIAL SPACES

Reading and listening

Rosalind Franklin

My name is Rosalind Franklin, chemist and crystallographer, and I was born in London in 1920. I have been interested in science since I was a little girl. When I turned 18 years old, I entered Newnham College in Cambridge. After graduating, I worked for the British Coal Utilisation Research Association, where I analysed the composition of coal by examining its porosity and behavior at high temperatures. Thanks to my ongoing research I published work on this material. It is extracted from deposits in the Earth's crust and has been an essential energy resource for industry during the century that I live in. The use of this raw material became widespread after the First Industrial Revolution, which took place in Great Britain in the 18th century.

Apart from studying minerals like coal, I specialised in the examination of materials using X-ray, which has allowed me to obtain very significant results in various scientific fields.

For a better understanding of the secondary sector and industrial spaces you are going to learn about:

- The secondary sector
- The basis of industrial activity: raw materials, traditional and alternative energy sources
- Energy in the world: saving and challenges
- The evolution of industry and its landscapes. Industry and globalisation
- Industry in the future: industry 4.0

1 Read the text and answer the following questions:

a) What did Rosalind do in the BCURA?

b) Where is coal extracted from?

c) What century did the First Industrial Revolution take place in in Britain?

d) What technique did Rosalind use to examine materials?

2 Why has coal been so important for industry?

LANGUAGE BANK

SPEAKING

DO IT, PLEASE

3 In groups of four, list all the kinds of energy sources you know. Then, try to decide whether they are renewable or non-renewable.

4 Discuss with your classmates and try to agree on the best energy source for a country, considering economic and environmental issues. You can consider factors like sustainability, pollution and cost.

WRITING

5 As the mayor of an industrialised coastal city, you read an article about Inna Braverman. She is the cofounder of Eco Wave Power, a company that uses power from ocean waves to generate electricity. Write a letter to her company asking for information about this type of energy production because you think it might be a good option for your city.

CHALLENGES THAT LEAVE THEIR MARK

LEARNING SEQUENCE

5 WHAT MINERALS AND ENERGY SOURCES DO YOU NEED TO OBTAIN YOUR PRODUCTS? WOULD IT BE POSSIBLE TO REDUCE THEIR IMPACT ON THE ENVIRONMENT?

5.1 Once you have defined some of the raw materials that are going to make up your product, determine what products of geological origin (minerals, rocks, energy products) you might need and what kind of energy you will need to make it. As you will see, it is not a clean process. Rather, it has a deep impact on the environment that surrounds you.

6 HOW DO WE TRANSFORM RAW MATERIALS INTO FINISHED PRODUCTS? DOES THIS PROCESS HAVE AN IMPACT ON THE ENVIRONMENT?

6.1 Now you know what raw materials you are going to use and what energy sources you need to transform them into your products. Establish how the products that you consume daily are transformed, and reflect on the consequences that these processes have for the land.

+ for guidelines, go to **anayaeducacion.es**

1

THE SECONDARY SECTOR

The **secondary sector** includes economic activities concerned with transforming raw materials into products that enable human needs to be met. The main activities are industry, mining, energy production and the construction industry.

Industry is the sector's most important activity, so industrial spaces are what best represent the sector's activity.

1.1 Industry

Industry is the activity that transforms raw materials into manufactured products that are suitable for direct consumption; or into semi-finished products that can be used as raw materials in an additional industrial process.

To undertake this activity, industry requires three elements:

- **Raw materials.** These are natural resources that industry transforms into manufactured or semi-finished products.
- **Energy sources.** These are natural resources that provide the force required to undertake the industrial transformation of raw materials.
- **Production factors.** These are employees, or the labour force; capital, or the goods required to undertake production (buildings, machinery, money); and technology, or the combined knowledge or methods employed in production.

1.2 Mining, energy and construction

- **Mining** is concerned with locating, extracting and refining rocks and minerals that are found on or in the subsoil.

  Raw materials are just a small part of the Earth's crust, and furthermore their distribution is unequal.

  Therefore, to exploit these resources, mining uses **prospecting methods** to locate minerals; **extraction techniques** to obtain minerals from open cast mines or from subterranean mines; and **refining systems** to separate the mineral that can be used, or ore, from the rock that contains it.

- **Energy production** transforms energy sources into heat and electricity that allow industrial work to be undertaken.

  This transformation takes place in power stations or facilities that are specialised for each type of energy source: thermal, nuclear, wind, solar, water, etc.

- The **construction industry** creates different types of structures (buildings) and infrastructure (roads, bridges, reservoirs, etc.).

  To complete them it requires plans and building materials such as steel and concrete, which are the world's most widely used materials in construction.

Secondary sector activities

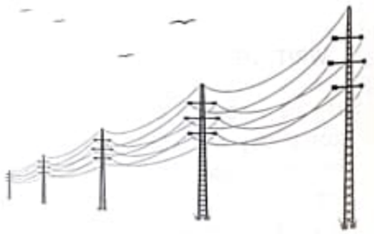
Industry

The range of activities that enable the transformation of raw materials into consumer products.

Mining

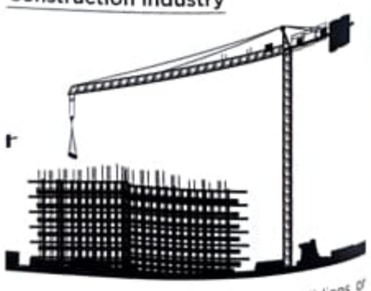
The range of processes that enable the extraction of minerals located in subterranean or open-air deposits.

Energy production



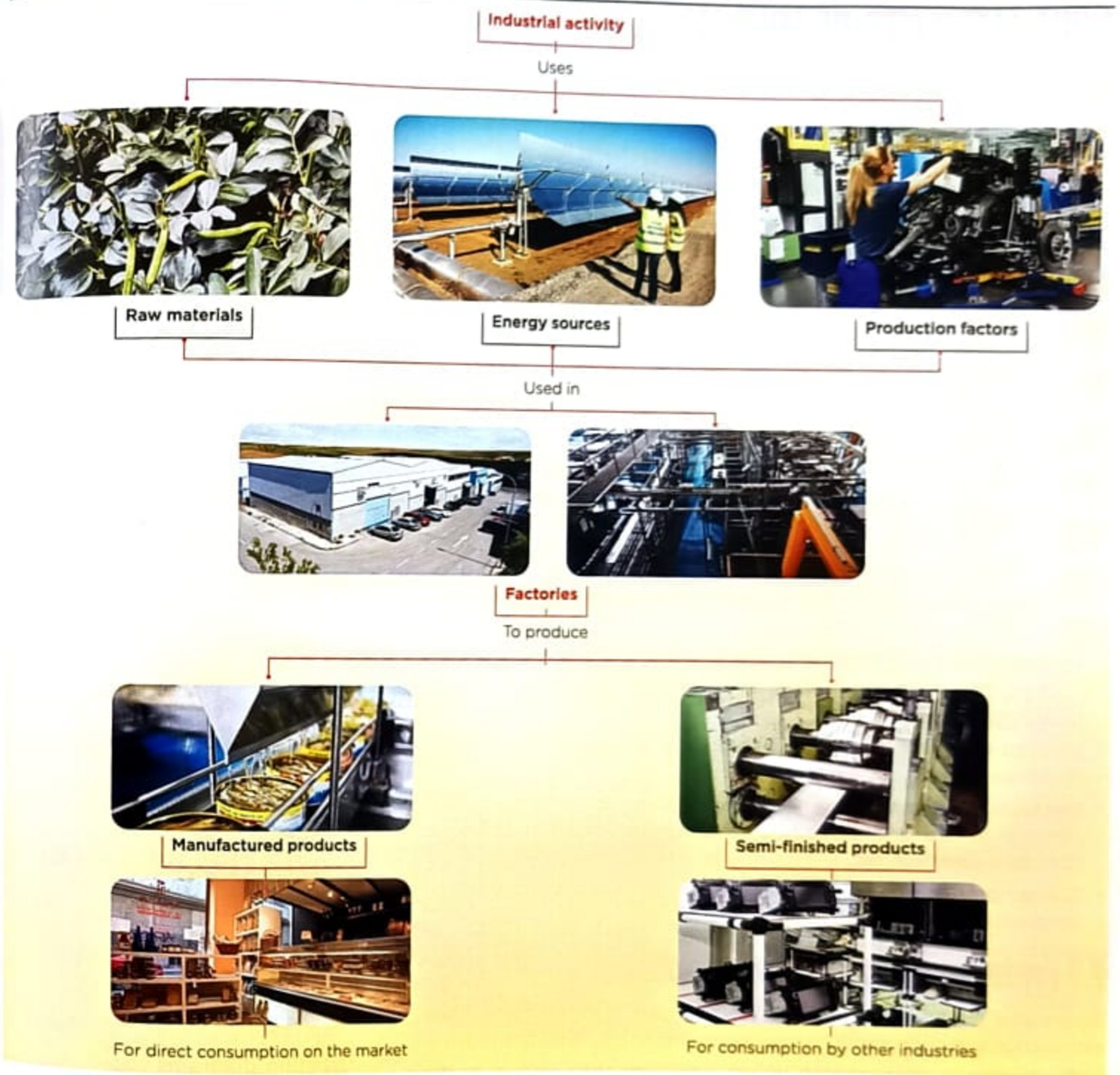
The creation of heat or electricity in specialised installations, known as power stations.

Construction industry



The technique of constructing buildings or infrastructure. Today, it is a core industry due to its economic importance.

The transformation of raw materials



Skills progress

Establishing relationships

1 What is the relationship between industry, raw materials and energy sources?

Summarising

2 Compare each of the secondary sector activities. State what they involve and require in order to carry out their activity.

Using terms and concepts

3 Explain what the following are: a factory, a mine, a power station and infrastructure.

Using images

4 Using the diagram above, describe what industrial activity involves. Use suitable geographical terminology.

2

CORE ELEMENTS OF INDUSTRIAL ACTIVITY (I). RAW MATERIALS

2.1 Industrial raw materials

These raw materials are natural resources that industry transforms into manufactured or semi-finished products. According to their origin they can be classified as plant, animal or geological matter.

Plant-sourced raw materials

They are obtained from agriculture and silviculture. An example of materials supplied by agriculture are industrial crops such as sugar beets, cotton, linen and tobacco. Silviculture provides woods, cellulose, rubber and cork.

Animal-sourced raw materials

They are provided by livestock farming and include hides, wool and silk, and by the fishing industry, for example, fish for canning or oil production.

Geological raw materials

They are extracted from the Earth's crust where they are found concentrated in deposits. These include:

- **Minerals,** from which metals can be obtained (iron, lead, aluminium, copper, zinc, precious metals) and non-metallic materials (glass, gems and fertilisers).

  Minerals represent the largest quantity and variety of industrial raw materials.
- **Rocks,** such as granite, clay, limestone and marble, which are used directly or for manufacturing construction materials: cement, concrete, ceramics, etc.
- **Energy products,** such as coal, crude oil, natural gas and uranium, from which energy is obtained.

2.2 Production and trade in raw materials

Today, raw materials are a very important part of global trade. Their production and consumption varies according to countries and regions.

- **Production** is concentrated in just a few countries known as the CARBS –Canada, Australia, Russia, Brazil and South Africa–, which own between 25% and 50% of the main natural resources.

  In addition to the CARBS, there is the United States and China; while some countries have specific resources, for example the Middle Eastern countries (crude oil) and some poor countries (cocoa in Ivory Coast and coltan in the Democratic Republic of the Congo).
- **Consumption** of raw materials is concentrated in Western Europe, Japan, the United States, and emerging countries such as China and India, which import them in huge quantities for use in their industrial sectors.

Types of raw materials

Plant-sourced

Sugar beet

Animal-sourced

Tuna

Geological

Oil

Skills progress

Creating diagrams

1 Draw a diagram on the types of raw materials.

ICT skills

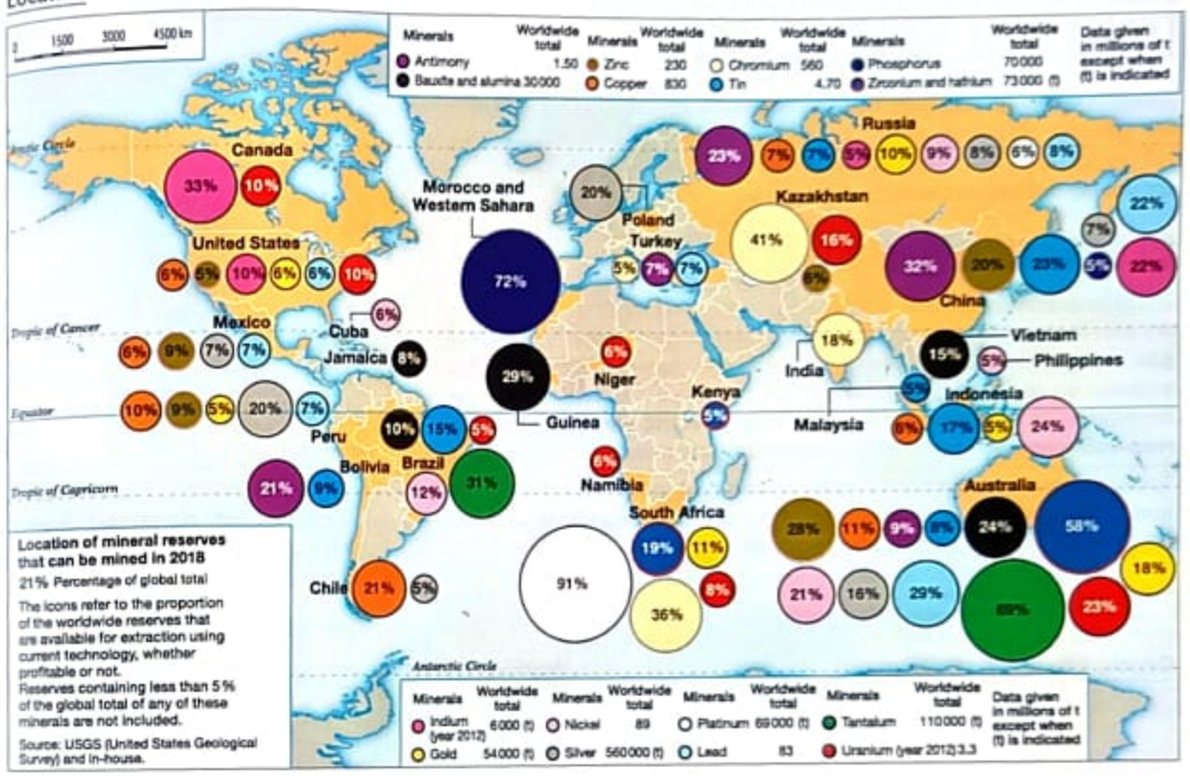
2 Choose three minerals and find information on their industrial use.

Handling maps

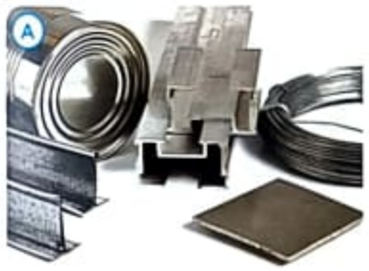
3 According to the map, which countries have the largest mineral resources?

The importance of minerals

Location



Some types of minerals



Minerals are vital for the operation of industry. Therefore, developed countries seek to ensure the global trade in this type of raw material.

A. Aluminium materials

B. Copper

2.3 Contemporary problems with regard to raw materials

- **Raw materials for the agrarian and food industries** are becoming scarce due to the high increase in global demand and their use as biofuels. This has led to food shortages and higher prices, which has had the worst impact on the poorest consumers.
- **Geological raw materials** pose two problems: firstly, their scarcity, as they are not renewable resources, and secondly, their uneven distribution. Therefore, wealthy countries, for whom they are essential, seek to ensure their supply by controlling both international markets and trade with producer countries.

Generating your own ideas

4 Give your opinion: What measures can be adopted to slow the depletion of mineral resources?

3

CORE ELEMENTS OF INDUSTRIAL ACTIVITY (II). TRADITIONAL ENERGY SOURCES

There is a wide range of energy sources used by industry. These are usually classified as traditional or alternative, with regard to the importance of their use; and as renewable and non-renewable, according to their capacity to be renewed by natural means.

3.1 Traditional energy sources

Traditional energy sources are the ones most widely used because they are the most highly developed. This group includes **coal**, **oil**, **natural gas** and **nuclear fission energy.** They are all **non-renewable** energy sources, so their consumption implies that they are depleted in the long-term. This group also includes **hydroelectric energy,** which is a **renewable** energy source as it is continually renewed.

Today's energy production is led by oil and coal, which represent 31.3% and 29% respectively of the total. They are followed by natural gas (21.3%) and nuclear (4.8%) and hydroelectric (2.4%) power.

Skills progress

Interpreting the environment

1 Create a table to compare the origin and use of, as well as problems raised by, traditional energy resources.

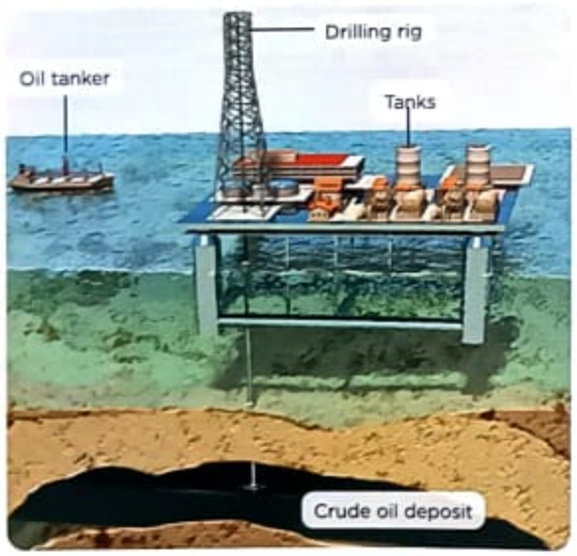
Using written texts

2 Using the data provided in the text, draw a graph showing the percentage of global energy consumption represented by traditional energy sources.

Handling maps

3 Place in a map the main producer countries of traditional energy resources. Make a key with the type of energy that they produce.

Crude oil



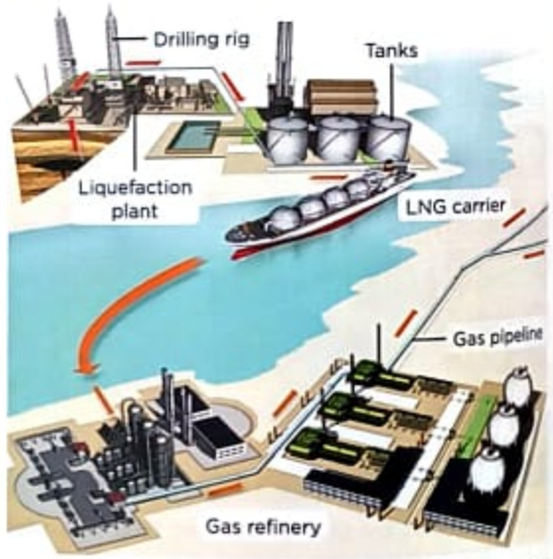
Crude oil is a mixture of hydrocarbons found in subterranean deposits. It is a by-product of the decomposition of animals and plants buried in a watery environment millions of years ago.

It provides petrol, tar, paints, plastic, etc.

The **main oil-producing** countries are Russia, Saudi Arabia, the USA, Iran, China and Mexico.

Their **reserves** may run out in 40 years. The **extraction process** produces high levels of pollutants and is criticised for its greenhouse gas emissions.

Natural gas



Natural gas has the same origin as crude oil and is often associated with it. Today, gas is also obtained by hydraulic fracturing or *fracking*. **It is used** to produce electricity in power stations, piped gas for central heating and kitchens, etc.

The **main** natural **gas-producing** countries are Russia, the USA, Canada, Iran, Norway and Algeria.

Their **reserves** may run out in 65 years. The traditional **extraction** methods also produce pollution, but less than crude oil. *Fracking*, in contrast, causes serious environmental damage.

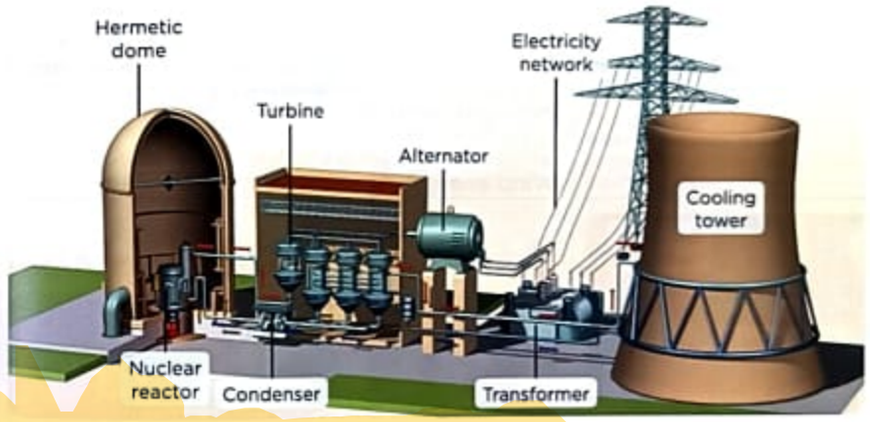
Coal

Coal is a combustible mineral produced by the decomposition of plant remains buried underground for millions of years. It is used to produce electricity in power stations, to manufacture iron and steel in iron and steel works, and to produce gas and other chemical products.

The **main producers** of coal are China, the United States, India and Australia. There are abundant **reserves,** but it is used less today due to the high levels of pollution it creates.

How does it works

Nuclear fission power



Nuclear fission power is obtained from the separation or fission of the atoms of radioactive heavy minerals such as uranium.

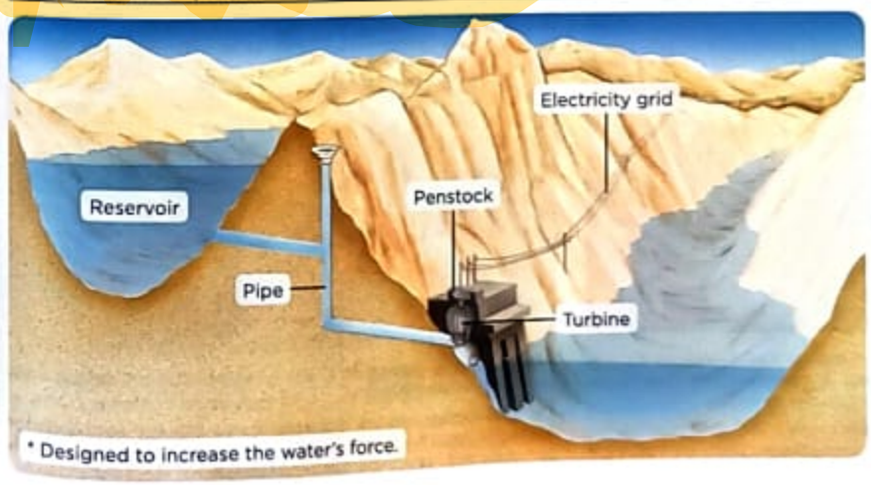
It is used above all to produce electricity in nuclear power stations.

The **main producers** are the United States, France and Japan.

It is criticised because it can cause nuclear accidents, and because it produces highly polluting waste.

La última morada de Chernóbil

Nuclear fission power



Hydroelectric energy is obtained from water contained in a reservoir, and **it is used,** above all, to produce electricity in hydroelectric power stations.

The **main producers** are Canada, the United States, Brazil, China and Russia.

It has been criticised for changing river courses and thereby, the lives of plants and animals.

4

CORE ELEMENTS OF INDUSTRIAL ACTIVITY (III). ALTERNATIVE ENERGY SOURCES

4.1 Alternative and clean energy sources

Alternative energy sources are those that have been developed as an alternative to the traditional or established sources. Their development began with the 1973 Oil Crisis, which forced industrialised countries to seek new energy options.

The most important ones are **biomass, wind** and **solar** energy. Other sources that are also being explored are **geothermal** energy and **wave** power. Finally, **nuclear fusion energy** is at an experimental stage.

All of these are **renewable** energy sources and can be considered **clean or green,** as they do not pollute or generate waste.

At present, these sources are used on a limited scale as the necessary technology is being developed or they are still too expensive to use.

Skills progress

Interpreting the environment

1 Compare the origin, use and problems raised by alternative energy sources in a table.

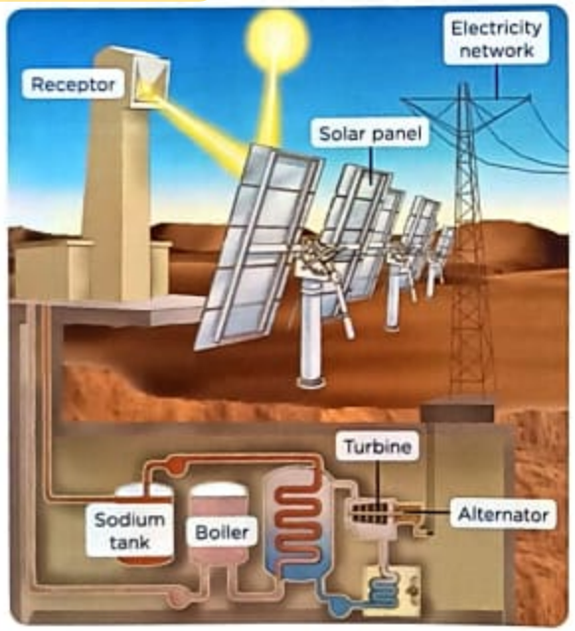
Using sources of information

2 With the information you have, answer: What percentage of global energy production is represented by alternative energy sources?

Handling maps

3 On a political world map, locate the main production countries of alternative energy sources. Create a legend showing which type of energy is produced in each of them.

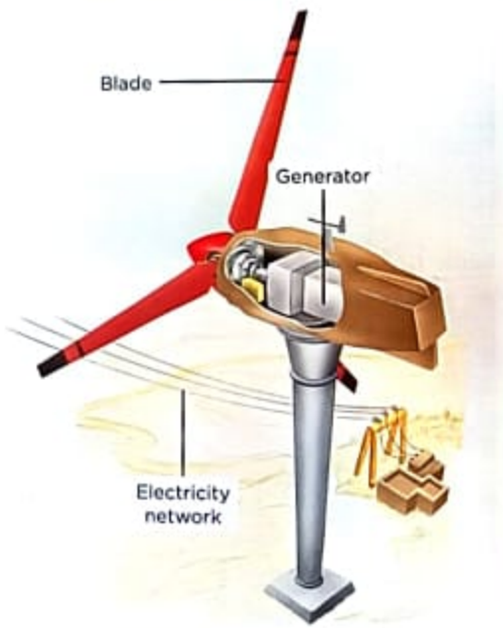
Solar energy



Solar energy is derived from the Sun's light and heat. Its force is concentrated by using panels, and it **provides** heat (hot water, heating) or electricity.

The **main producers** are the USA, Canada and Australia. Its problems are the irregular (daily and annual) energy supply and the challenge of storing it.

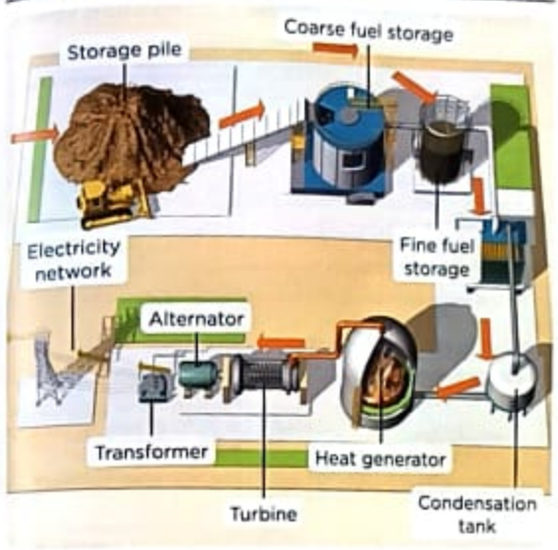
Wind energy



Wind energy is derived from the wind, which turns generators in order to **provide** electricity.

The **main producers** are Germany, Spain and the United States. Among its most noteworthy problems are the irregular wind supply and visual and noise impact of wind turbines.

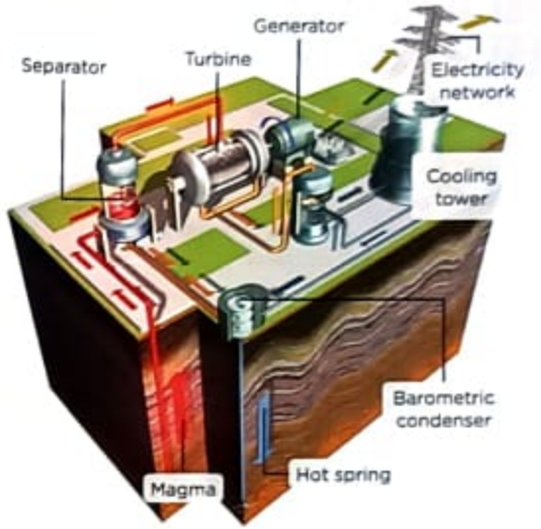
Biomass energy



Biomass energy is derived from agricultural, livestock and silviculture by-products or else produced by industries that transform raw materials from these sectors. The burning of biomass fuel provides heat and electricity.

The **main producers** are the United States, France and Sweden. The major **problem** of the biomass energy is CO_2 emitted during combustion.

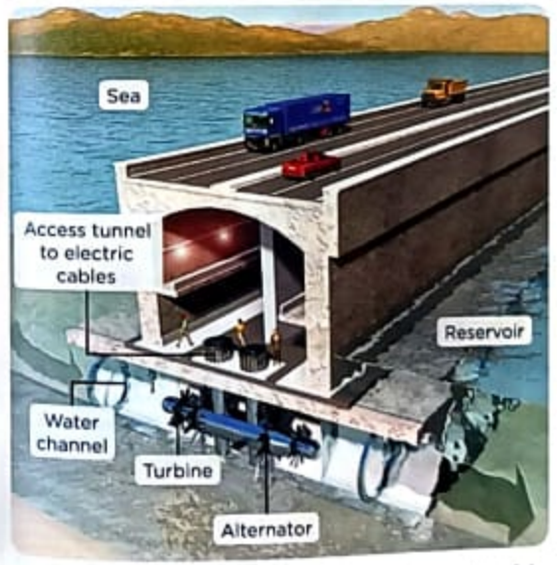
Geothermal energy



Geothermal energy is derived from the Earth's internal heat, and it is used to heat water, provide heating and produce electricity.

The **main producers** are the USA, the Philippines and Mexico. The **problem** it raises is that access to the most powerful supplies is restricted, as they are found in areas with volcanic or seismic activity. Meanwhile those with less power are expensive to operate.

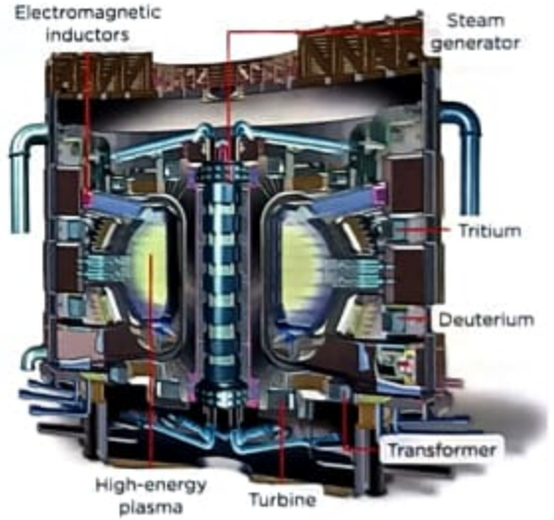
Wave power



Wave energy is derived from the power of the tides or waves of the sea and is used to produce electricity.

The **main producers** are France, Great Britain and Canada. The **problems** it gives rise to are high production costs, wave variability and visual impact.

Nuclear energy



Nuclear fusion energy is derived from the union or fusion of low-mass atoms of deuterium and tritium, two hydrogen isotopes obtained from sea water that can produce large amounts of energy. The **problems** it raises (high temperatures and controlling the nuclear reaction) remain to be resolved.

5

THE WORLD'S ENERGY. ENERGY SAVING

Energy is necessary for our daily life. It enables transport, machines and household appliances to function, and lights our houses, offices and shops. However, energy production and consumption is distributed very unequally around the world, which gives rise to serious problems.

5.1 Energy problems

- **The rise in the world's energy production and consumption** is constant due to the increasing population and expansion of economic activity.
- **The majority of global energy needs** are covered by non-renewable energy sources, some of which may run out in the coming decades.
- **The unequal distribution of energy resources** obliges non-producing countries to pay for costly imports, which generates a serious dependency on energy-producing countries. On occasions, attempts to control these resources has resulted in international conflicts, such as the First Gulf War (1990-1991). Energy supplies have also been used as a form of political pressure by countries such as Russia.
- **Energy production gives rise to serious environmental problems.** These include the depletion of resources, and atmospheric, land and sea pollution caused by industrial and energy production facilities, as well as heating and transport.

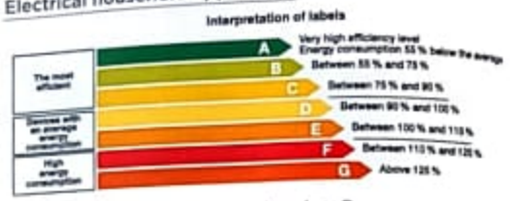
5.2 Energy policies

Today, the majority of countries have adopted energy policies. Their aim is to limit the negative environmental effects and save energy.

- **Environmental policies** seek to reduce emissions from major energy-producing and industrial facilities, as well as in the transport sector.
- **Energy-saving policies** aim to reduce energy consumption. To do so they raise the awareness of consumers (families, industry, transport companies and the services sector) regarding energy-saving measures and the use of low-consumption technology.

How to save energy in the home

Electrical household appliances



Buy models certified as energy class A or B.

Do not put hot food in the fridge.

Fill the washing machine and dishwasher to full capacity.

Heating and air conditioning

Improve household insulation.

Maintain indoor temperature at 21 °C in both winter and summer.

Use only when necessary.

Television, computer, etc.

Reduce the periods of time they are used.

Do not leave devices on stand-by. Switch them off when they are not being used.

Activate energy-saving applications on devices.

Lighting

Replace conventional bulbs with low-energy models.

Skills progress

Finding relevant information

1 What are the main global energy problems?

Questioning technological development

2 Create a practical guide with advice on how to disseminate household energy saving tips.

Energy production and consumption

Energy producers

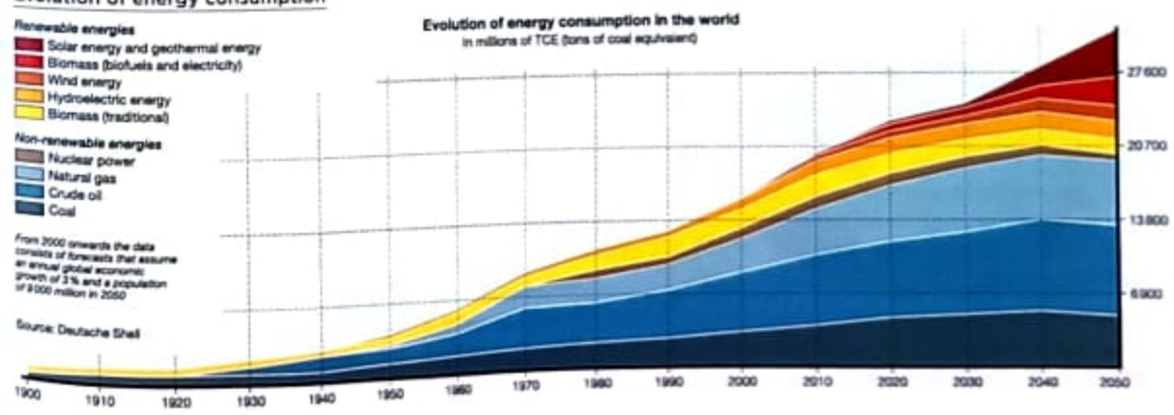
Energy production and consumption by region

Year 2015	Global energy production %	Global energy consumption %
OECD	30.19	38.6
Middle East	13.66	5.1
Europe and Asia, non-OECD countries	13.29	7.5
China	18.10	20.4
Asia	10.72	13.2
America, non-OECD countries	5.9	5.0
Africa	8.1	6.1

Source: Key World Energy Statistics 2017. AIE.

The **main global energy consumers** are the most developed (OECD) countries, where industry, transport, the services sector and homes consume a lot of energy. Together, the energy consumption levels in this group are well above production levels. Some emerging countries that have a high population and are undergoing a rapid industrialisation process, such as China, are also major consumers.

Evolution of energy consumption



Organisation for Economic Co-operation and Development

Handling maps

3 Identify and locate the world's main energy producers.

Handling graphs

4 Find information in the graphs: a) How has energy consumption evolved? b) Which countries are the major energy consumers? c) What problems are revealed by these graphs?

GRAPHIC REPORT

Technology and its new uses and materials

Human beings have always strived to transform and take advantage of natural resources. Currently, the new ways of producing energy and the exploitation of minerals used in the manufacturing of technological products particularly stand out.

- Among the new ways of obtaining energy, the most recent and controversial is hydraulic fracturing or *fracking*, which is used to extract oil and gas from unconventional sites.
- The minerals used in high-consumption technological products *(smartphones, game consoles, MP4, LEDs, hybrid cars, etc.)* are, in many cases, critical minerals, whose production is concentrated in just a few countries.

The best-known example is the so-called "rare earth elements" (REE).

Skills progress

Comprehension, expression and ICT

1 Define *fracking* and critical minerals.

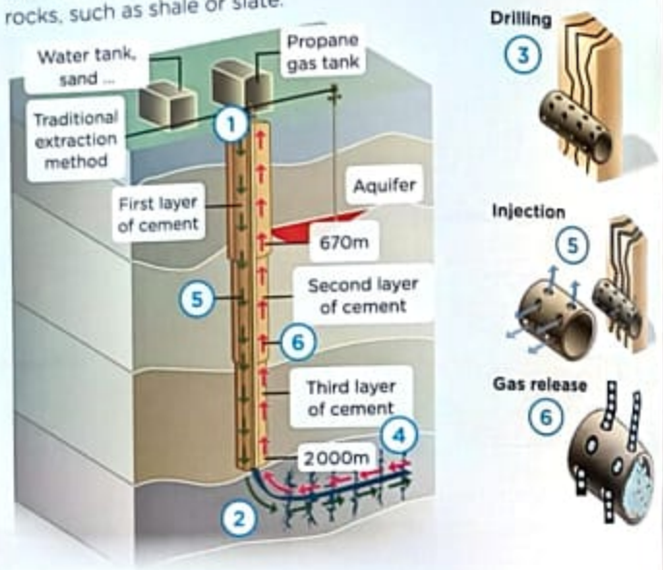
2 Using the information in the drawing, explain the process of obtaining oil and gas using the *fracking* technique. Find out about it and express your opinion on whether or not this technique of obtaining hydrocarbons should be prohibited or not.

3 Consult the map and cite the main producing countries of critical minerals, grouping them by continents.

Hydraulic fracturing or *fracking*

1. The method

It is used to extract oil and natural gas from certain sedimentary rocks, such as shale or slate.



How does it works

2. The process

Drilling. It is done vertically until reaching the stratum of hydrocarbons **(1)**, and horizontally around 3000 metres **(2)**. Then a steel pipe is inserted into the well, which is covered with cement. **(3)**, controlled explosions are carried out that slightly fracture the rocks that contain hydrocarbons **(4)**.

Injection. Large quantities of water mixed with sand and chemicals are injected through the pipeline under pressure **(5)**.

With this, the fractures of the rock increase and the hydrocarbons are released. This process is repeated about fifteen times.

Gas release. The injected water is extracted to the outside, which is then followed by the gas or oil **(6)**.

3. The arguments for and against

Fracking has defenders, who highlight the advantages, and opponents, who emphasise the disadvantages of the method.

Advantages: an increase in the availability of energy; a reduction of imports; the possibility of helping to contain energy prices.

Disadvantages: extraction is expensive; it can contaminate the soil, aquifers and surface waters; it consumes large amounts of water; return waters contain chemicals; the exploitation platforms produce noise and have landscaping impacts.

The denunciation of indigenous exploitation and the New Laws

1. Location, examples and applications

Some raw materials are of crucial importance. Among them are **critical minerals,** so called because the risk that their scarcity would entail and the economic impact that this would bring about are greater than those of other raw materials.

The high risk to supply is due to the fact that their production is concentrated to just a few countries, they are barely substitutable for other minerals and have low recycling rates.

The **main producing countries** are China (antimony, fluorite, gallium, germanium, graphite, indium, magnesium, rare earth elements and tungsten), Russia (PGM or platinum group minerals), Democratic Republic of Congo (coltan and tantalum) and Brazil (niobium and tantalum).

Germanium (A). Critical mineral that has various applications: fibre optics, electronics, lens manufacturing.

Graphite (B). Mineral mines used to manufacture pencils, and engineering parts such as pistons, bearings, etc.

2. The rare-earth elements

A group of 17 elements from the periodic table that, theoretically, are transition metals.

They are counted as critical minerals, and their current **applications** are very varied: mobile screens and speakers, fibre-optic cables, computer hard drives, solar or LED cells, hybrid car batteries, X-ray machines, etc.

Of the 62 chemical elements most used in the technological industry, at least ten don't have a replacement yet. Among them are several rare-earth elements.

Materials provided by rare-earth elements cannot easily be replaced. Therefore, they have become a fundamental piece of current technology and a matter of vital importance to great powers.

Deposits of rare-earth elements containing a high concentration of minerals are very scarce; most of them are in China, who has a monopoly on their trade.

Rare metals recycled from old devices. Laboratory in Goslar, Germany.

7

INDUSTRIAL DEVELOPMENT AND ITS LANDSCAPES (II)

7.1 Contemporary industry

Contemporary industry emerged in the mid 20th century thanks to innovations from what is known as the Third Industrial Revolution.

Industrial labour now uses new technologies (microelectronics, computer systems and telecommunications), which enable the use of computer-controlled machines and industrial robots; it incorporates new materials (like polymers and Nomex); and it introduces new energy sources (nuclear and alternative energy sources).

Manufacturing takes place in small establishments and the different production phases are distributed between them.

Fewer, yet highly qualified, employees work in these new manufacturing establishments and they are accompanied by a range of other employees who work on related services, such as research, innovation, marketing, design, quality control, etc.

The resulting **production process** can be applied to manufacturing in short series of cheap and diverse products, adapted to consumer tastes and intended for a global market.

The main sectors are telematics, microelectronics, lasers, aeronautics, biotechnology and new materials.

7.2 Contemporary industrial landscapes

- **Traditional industrial landscapes** underwent a crisis in the 1970s, because these industries had become outdated.

  In some cases they underwent **reconversion** through closure or by implementing changes to production and the workforce.

  At the same time, **reindustrialisation** was promoted, which strengthened the establishment of new industries.

  In other cases, **physical relocation or offshoring** was used in order to find cheaper areas.

- **Innovative and high tech industries** have become established in **science parks** or technopolis often located in the most economically flourishing cities. They provide a meeting point between qualified workers, infrastructure support and advanced services.

- **Other traditional industries** have left urban centres and relocated to traditional **industrial estates;** or to **industrial parks** that combine industry with office buildings, or if profitable, to the outskirts of cities or rural regions.

- **In newly industrialised countries** enormous industrial complexes have been created, preferably near ports from which products are exported. As a rule there is no environmental legislation in these locations and they host* highly polluting industries.

The new industries

Contemporary industry is focused on **innovative sectors.** In general, **few** but **highly qualified workers** are employed.

Focus on English

host: to provide the space necessary for something.

Skills progress

Creating diagrams

1 In your notebook, complete a summary listing the characteristics of contemporary industry.

Handling concepts

2 Explain the difference between an industrial estate, an industrial park, a science park and a high-tech hub.

Contemporary industrial landscapes

Distinguishing essential ideas

3 What do the terms *reconversion, offshoring and reindustrialisation* mean?

Researching processes

4 Find an image of an industry, then identify it and summarise its characteristics.

5 With two classmates, study an industrial landscape that is in a period of recession.

It should include information about its problems and characteristics, and the plans for possible solutions.

SKILL → Go to preparing and presenting a piece of work

Today, some of the older industries have closed and left behind **a landscape of industrial ruins,** such as this nuclear power plant the Crimea peninsula **(1)**.

Others have been restored to provide a testimony of their past use as a site for industry. An example of this is the **New Lanark industrial textile mill** (Scotland), where the factories closed in 1968. Later, it was restored for tourism and cultural use and declared a UNESCO World Heritage Site **(2)**.

Technology parks, such as the Alava Technology Park **(3)**, bring together high-tech industries.

High-tech hubs (4), such as North America's Silicon Valley (California), bring together innovative industries in a location with good environmental conditions combined with advanced infrastructure and services.

8

INDUSTRY AND GLOBALISATION (I). TYPES OF LOCATION AND RELATED FACTORS

8.1 Types of contemporary industry

As a result of their historical development, contemporary industries are highly varied and are classified according to the following criteria:

- **According to their position in the production process,** whereby three types are identified:
  - **Heavy industry** produces semi-finished products (iron and steel industry).
  - The **capital goods industry** transforms semi-finished products into equipment needed by other industries (machinery, industrial equipment) or for transport and construction.
  - The **consumer goods industry** manufactures products intended directly for consumers (textiles, food, etc.).
- **According to the weight of the raw material. Heavy industry** processes large quantities of heavy, raw materials, **semi-heavy industry** works with raw materials on a smaller scale, and **light industry** uses lightweight materials such as consumer goods.
- **According to its technology.** There are **low technology** or traditional industries such as the textile industry; **mature** technology, which has achieved its maximum technological development and become stagnant, such as the metalworking or car industry; and **high-tech** industries that are today undergoing major expansion, as is the case with computing, telecommunications and biotechnology.
- **According to its size.** They can be **small** (less than 50 workers), **medium-sized** (between 50 and 250) or **large** (more than 250).

8.2 Contemporary factors of industrial location

Today, as a result of economic globalisation, an international division of industrial work has been established.

- **High-tech industries** are located in the most developed countries as they require advanced services and infrastructure, a qualified labour force and consumers with a higher purchasing power. However, they are increasingly spreading towards developing countries such as China and India.
- **Mature or low-technology industries** tend to be located in emerging or underdeveloped countries, as they require an abundant, but relatively unqualified and low-cost labour force. These countries often provide special state concessions that encourage industries to move there, such as duty-free zones and permissive environmental legislation.

  Some of these industries come from developed countries, which has given rise to a phenomenon known as **industrial offshoring.**

Industries and technology

High-tech

Pharmaceutical manufacturing plant.

Low technology

Textile factory in New Delhi.

Skills progress

Creating diagrams

1 Draw a diagram representing the different types of industry.

Developing your own content

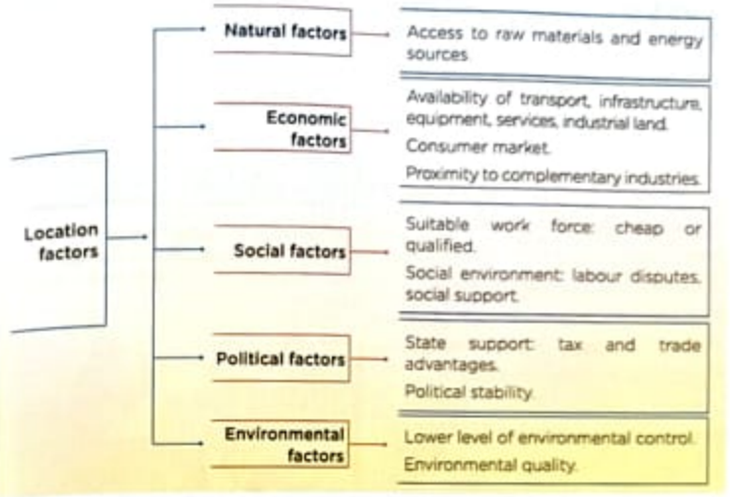
2 Imagine you are going to establish an industry in your municipality. What type would it be and what factors would you bear in mind in order to locate it in the most suitable place?

Finding relevant information

3 Search for relevant information to explain what is meant by a duty-free zone and the international division of industrial work.

Contemporary industrial landscapes

Location factors

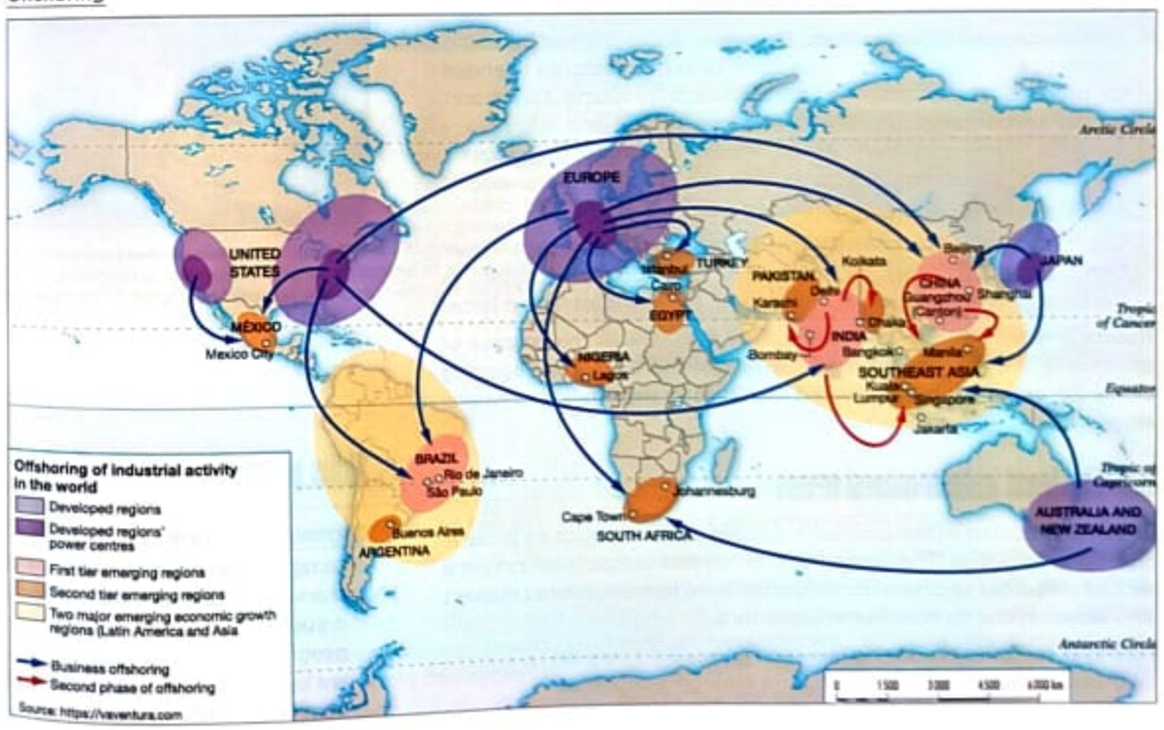


Industries **are located** in places that provide the most favourable conditions to earn the maximum profit.

Therefore, **industries that use heavyweight and high-volume raw materials** tend to be located near to where these are produced in order to save on transport costs, for example the Novelsa marble industry.

On the other hand, **industries that require a large labour force** tend to be located in regions with a high population of low-wage workers.

Offshoring



Working with maps

4 Study the map and answer the following: a) Which countries and regions are offshore industries from? b) To which countries, regions and cities are industries offshored? c) Why are they offshored?

SKILL → Go to working with maps. Thematic maps

In the "Apply skills" section you have the quiz: Offshoring

6

INDUSTRIAL DEVELOPMENT AND ITS LANDSCAPES (I)

Industrial activity has undergone a variety of phases characterised by the introduction of a range of technical advances, as well as the use of various energy sources. The industrial landscapes produced by this activity have also evolved over time.

6.1 Artisanal industry

Until the mid 18th century, **artisans** undertook **industrial labour** by hand using traditional tools and low-power energy sources, such as human or animal strength or wood burning.

Manufacturing was undertaken in small **workshops,** where the artisans produced their products. The final **products** were unique (having been commissioned by customers, no two dresses, for example, were the same), expensive and scarce; they were sold on the local market. Industry concentrated on basic sectors such as clothes, shoes and everyday items.

The **location** of artisanal workshops was widely distributed, as there was no distinguishable **industrial landscape.** However, many artisans preferred to establish themselves in cities, where the members of different trades congregated in specific streets, which gave rise to urban spaces specialised in weaving*, metalworking, tanning*, etc.

6.2 Modern industry

Modern industry began in Great Britain in the wake of the First Industrial Revolution (1770–1850), and continued during the Second Industrial Revolution (1850–1950). **Industrial labour** went on to be carried out by machines powered by more powerful energy sources, such as steam engines, which were coal powered during the first industrial revolution, and electric motors and piston engines moved by electricity and petrol during the second industrial revolution.

Manufacturing was focused in **large mills** or **factories,** where numerous **workers** made just one part of a product. The resulting **products** were abundant, cheap and homogenous, and sold on distant markets. To begin with, industrial activity was centred around the iron, steel and textile sectors, but it gradually diversified.

The **location** of industries and the **industrial landscapes** they gave rise to underwent major transformations during these centuries.

- During the **First Industrial Revolution,** industries were located near mining regions or other sources of energy, or else in ports and cities, near train stations. The **industrial landscape** was marked by tall, brick factory chimneys, unsanitary housing for workers and railways. The pollution created by these factories explains why this area was referred to as 'the **black country**'.
- During the **Second Industrial Revolution,** there was greater flexibility in the choice of industrial locations. Thus, ports attracted oil refineries, chemical industries and dockyards, while industries that preferred to be near consumers were clustered on the outskirts of cities. The most typical industrial landscapes were **industrial estates,** organised into plots with industrial spaces equipped with services, infrastructure and transport.

Artisans and workshops

In the past, **artisans** preferred to be located in cities, where they settled in streets given over to the practice of the same trade.

Artisan workshops were identified by distinctive signs and also served as a place to sell products.

Focus on English

weaving: the process of making cloth by interlacing threads.

tanning: the process of converting skins into leather.

Skills progress

Creating tables

1 Compare artisanal and modern industries by completing this table in your notebook:

	Artisanal	Modern
Chronology		
Labour and manufacturing		
Production		
Location		
Resulting landscape		

Using images

2 What differences do you see between artisanal and industrial labour?

3 And between the landscapes produced by the first and second industrial revolutions?

Workers and factories

In the **First Industrial Revolution,** machines (A) were powered by steam, which was generated by burning coal. The pollution caused as a result led to polluted landscapes, like the area around Birmingham, which came to be referred to as 'the black country'.

During the **Second Industrial Revolution,** industries began to establish themselves on the outskirts of cities (B).

9 INDUSTRY AND GLOBALISATION (II). THE WORLD'S INDUSTRIAL AREAS

The world's industrial areas are located in historical industrial regions and emerging countries. Recent development has been irregular.

9.1 The historical industrial regions

The United States, Japan and the **European Union** continue to be the world's three most important industrial areas.

They benefit from their advanced technology and the high spending power of their local markets. High-tech and innovative industry is especially important, and many large businesses have their headquarters in these regions. However, industry in these regions is in decline due to the offshoring of basic heavy industries (steel), and the loss of part of the consumer goods (textiles) and equipment (cars) industries to emerging countries.

9.2 Emerging countries

These are led by the **BRICS** (Brazil, Russia, India, China and South Africa) group followed by a number of regional industrial powers such as **Australia** and **New Zealand** and other secondary emerging countries. Their **highly developed and growing industrialisation** is due to:

- In some cases, the **exploitation of their abundant natural resources.**
- In other cases, to **globalisation.** This allows them to begin by taking advantage of their cheap labour force to set up factories intended to produce cheap low- or medium-tech products for export to developed countries. Then, with the capital and technology acquired, they can set up high-tech industries (aeronautics, electronics, telecommunications) intended for their extensive local market, as well as those of developed countries.

  Today, multinationals created in these countries have begun their own offshoring process and moved the least complex industries to the most underdeveloped countries with the cheapest labour force.

Russia is a special case in this group. In the wake of the collapse of communism, it lost its global industrial ranking. Since the beginning of the 21st century it has recovered thanks to its exploitation of natural resources.

9.3 The least industrialised areas

These are located in the poorest countries on Earth, such as those in Sub-Saharan Africa. The causes of their limited industrialisation are a lack of resources or capital for industrial development, limited markets and isolation due to poor communications.

However, factories producing low-tech goods are being set up in some of these countries by businesses from emerging countries.

Industrial areas

The **historical industrial regions** such as the United States, Japan and the European Union have extensive industrial zones that use advanced technology.

The industrial development of **emerging countries,** such as China, South Korea, India, Brazil and Mexico, is due to globalisation.

The **least industrialised areas** on Earth are located in underdeveloped countries, which lack the resources and capital for industrial development.

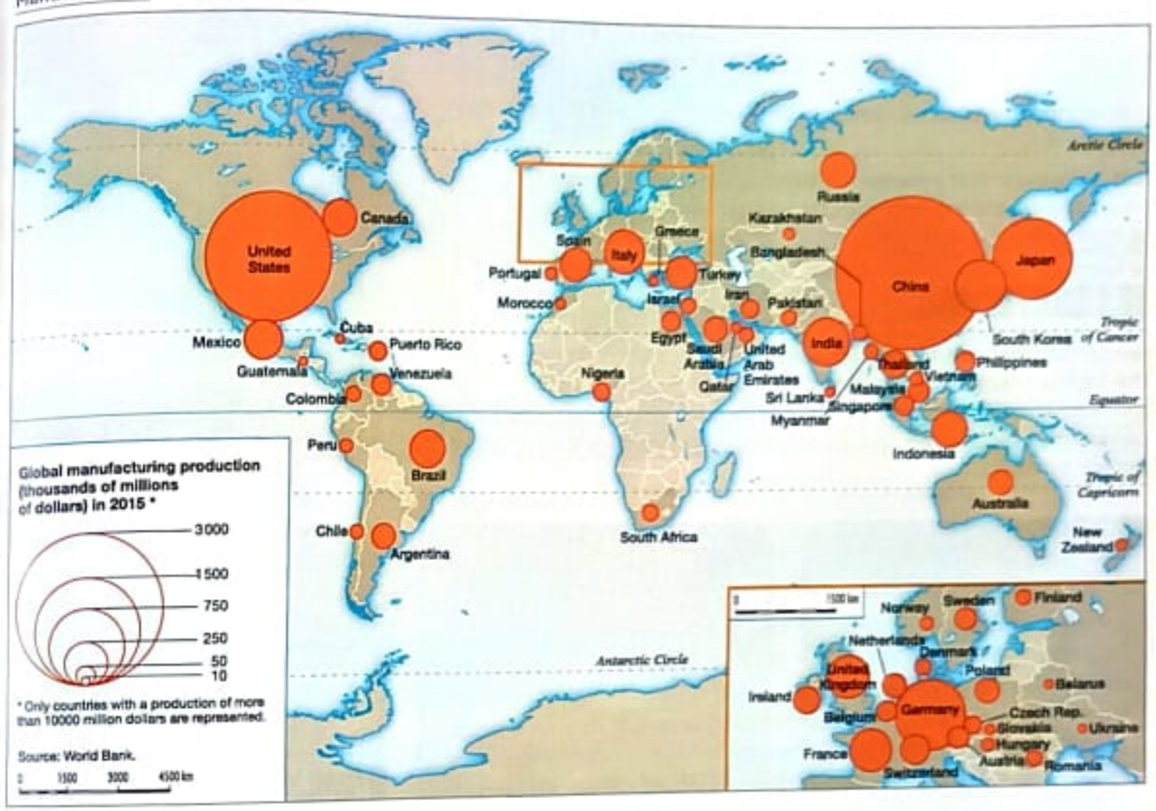
Skills progress

Organising information

Using a table, summarise the characteristics of the world's industrial regions. Include: geographical zones where they are located, types of industry and current state of development.

Industrial development zones

Manufacturing



Industrial 'offshoring'

Today, western countries have undertaken what is known as industrial 'offshoring', or reversed previously offshored industries.

There are many reasons for this: transport expenses, due to the continual changes in petrol prices; rises in labour costs in some countries such as China; conflicts between businesses and their partners in emerging countries due to the improper use of knowledge or customer relations; failures to fulfil quality specifications; insufficient training of local workers; and the costs created by working over long distances.

The value of manufacturing production in 2011

China	3250	Indonesia	180	Saudi Arabia	82
USA	2159	Canada	175	Netherlands	81
Japan	910	Russian	173	Sweden	68
Germany	700	Spain	154	Malaysia	67
Rep. of Korea	374	Turkey	143	Austria	63
India	323	Switzerland	121	Belgium	58
Italy	263	Thailand	110	Venezuela	58
Great Britain	258	Ireland	99	Philippines	58
France	254	Australia	85	Egypt	55
Mexico	200	Argentina	84	Singapore	54
Brazil	189	Poland	84	Puerto Rico	48

Source: World Bank. In billions of dollars.

Using maps

I think, I'm interested, I investigate

1 Study the map and complete the following tasks:

a) Name the historical industrial regions and the major emerging industrial regions.

b) Which is the world's least industrialised region? Explain the reasons for its limited industrialisation, as well as the current developments taking place.

Representing information

2 Using the data provided in the table:

a) Create a graph showing the countries' levels of industrial production. b) Locate them on a map. c) Classify them into groups according to their level of development. d) State the contemporary development that characterises the industrial production for each group.

10

FUTURE INDUSTRY: INDUSTRY 4.0

Future industry advances towards the Fourth Industrial Revolution or Industry 4.0.

It is a concept that emerged in Germany in 2010. It is designated to smart manufacturing and consists of digitising production processes to make them more efficient.

10.1 Smart factories

Smart factories are characterised by the automation of production; the interconnection of machines within the industrial site itself; and the exchange of information on the outside (markets, customers, competitors and other smart factories) to streamline and improve decision making.

10.2 Technologies

The essential **technologies** for Industry 4.0 are:

- **Internet of things.** It consists of connecting objects to the Internet by integrating a chip, in order to provide intelligent information and services.
- In the industrial field, it has numerous applications: the improvement of the manufacturing and management process, machinery supervision, quality control, safety improvement, etc. This technology also enables intelligent communication between things via the Internet.
- **Cyber-physical systems.** Allows a physical object to be controlled by technology, like the power grid, or industrial machines. In turn, cyber-physical systems are connected to each other through the Internet of Things.
- **3D printing.** Creates three-dimensional objects. It allows the prototyping of any product and its hyper-personalisation. It doesn't make the product more expensive, regardless of whether you have to manufacture the same or different parts, making it much easier to produce small batches. It is mostly used for product design.
- **Big data.** Consists of the harvesting, management, interpretation and storage of a huge amount of data for business purposes. It allows for improvement in the manufacturing processes through analysing results, making decisions, predicting results, anticipating markets, carrying out simulations to predict the necessary resources and optimising their use, developing new business models, studying consumer habits, acquiring and retaining customers, etc.
- **Artificial intelligence.** Technology that enables machines to behave intelligently. It is able to process large volumes of information in real time and learn autonomously from the information received to develop actions, such as maximizing functions or solving problems.

Smart manufacturing

Geography and History

Create You are going to create a factory and decide on its location. Do some research to find the most suitable area for the production of the factory, taking into account the necessary factors.

Skills progress

Generating your own ideas

1 What are the advantages and disadvantages of the digitisation of industry?

Automation and new technologies

Task automation allows manual workers to be replaced by **robots**. A robot is a programmable machine, that has humanoid features, of which the most typical are its articulated arms with which it can perform tasks, especially the most repetitive, harmful, dangerous or exhausting tasks.

Thus, "blue collar" manual workers are replaced by "steel collar" workers, leaving unskilled workers to supervise or monitor.

3D Printing

It allows the creation of **prototypes** that respond to particular demands. Automated and reprogrammable machines can manufacture them in short series at profitable prices.

Big data

It is capable of **storing and processing** data of enormous volume and complexity to quickly get useful information. It enables companies to make decisions.

Augmented reality

This technology, like virtual reality, enriches visual quality. Augmented reality adds virtual information to reality, creating a mixed reality.

- **Collaborative robotics** (Cobot). A new generation of industrial robots. They are small in size, highly flexible, and able to collaborate and interact closely with people.
- **Virtual and augmented reality.** Technologies that enrich visual quality by combining the real world with the virtual one through a computer process.
  - **Virtual reality** creates an environment and produces the feeling of the user being immersed in it.
  - **Augmented reality** allows you to visualise a part of the world through a technological device that adds virtual information to the real one. In industry it can be used to optimise designs, control production, facilitate *online* purchases (changing rooms for virtual clothes), train staff, etc.

CHALLENGES THAT LEAVE THEIR MARK

APPLY

1 Briefly define these geographic concepts: *raw material, energy source, construction, crude oil, energy saving, fracking, Industry 4.0.*

2 Complete the table below in your notebook:

Energy source	Origin	Use	Production countries	Advantages and disadvantages
Crude oil				
Solar energy				
Nuclear fission				

3 Identify and summarise the characteristics of the industrial space below.

REFLECT AND EVALUATE

Continue with secondary sector activities. Reflect individually and share in a group your assessment of the activities involved.

To do this, download the corresponding rubric at anayeducacion.es

TEST YOUR SKILLS

To test your knowledge of the secondary sector, fill out the self-assessment. You can find it at anayeducacion.es.

4 Read the text and then answer the following questions.

The change in the international location of industrial activities (...) has been the consequence of increasing economic globalisation. In other words, the growing foreign and domestic competition within national markets, the rapid expansion of large economies which offer important advantages for industries and, finally, the possibilities provided by computer technology with regard to structuring production processes.

These three factors have led the main multinational companies to channel their investments into emerging industrial economies (...) and close down operations in more developed countries. This is a phenomenon that has become known as 'offshoring'.

As a result of this process, the national economy loses a market with regard to certain activities and areas. These are subsequently taken over by another country which leads to a decrease in employment in the affected sector.

ipyme.org

a) What is offshoring?

b) What factors related to offshoring are mentioned?

c) Name some of the consequences of this process.

d) What relationship is there between offshoring and the new industrial countries marked on the map below?

PROTAGONISTS

IN THE PAST
Herta Marks Ayrton

Basic information

Name: Herta Marks Ayrton

Period: 1854-1923

Nationality: British

Occupation: mathematician, inventor and suffragette

In my childhood, my favourite subject was mathematics. I liked numbers so much that I founded a club together with Charlotte Scott and decided to study at Girton College in Cambridge.

In 1881, I obtained a Bachelor of Science from the University of London, because, although I had passed my studies at Cambridge, they didn't give titles to women there, only certificates, which helped me to become aware of and fight for women's rights.

In 1884, I patented my first invention and my conclusions allowed improvements to city lighting to take place. In 1899 I was the first woman to present a paper before the Institution of Electrical Engineers (IEE) and the first female member. My good reception at the IEE encouraged me to present my work to the Royal Society, but I was rejected as a woman and John Perry did it on my behalf in 1901. I kept trying and in 1904 I managed to defend my work in that same institution. Two years later, I received the Hugues Medal for my research on the electric arc and the waves produced by the sea.

In the years before World War I, I created a fan, known as the "flapper". It was used in the trenches, as it served to dissipate the mustard gas used in that battle which would claim so many lives. After the war, I collaborated in several associations that sought to achieve equality.

NOW
Inna Braverman

Basic information

Name: Inna Braverman, 1986

Place of birth: Ukraine

Occupation: Eco Wave Power coordinator

At the beginning of the 20th century, the previous protagonist, Hertha Marks, had been interested in studying the waves of the sea. Currently, in the 21st century, another woman, Inna Bravermann, is the co-founder of a company that uses the force of sea waves to obtain electricity.

In the same year that Inna was born, reactor number 4 in the Ukrainian nuclear power plant in Chernobyl overheated and the hydrogen that accumulated inside it exploded, causing the biggest nuclear accident in history. The disaster put 400 times more radioactive material into the atmosphere that that of the Hiroshima atomic bomb and the consequences on the health of the affected people are still being discovered today. Inna Braverman was one of these people, but she was lucky—she survived— and now dedicates her life to the study and diffusion of renewable energies.

She resides in Israel and in 2011 she founded Eco Wave Power, a company that obtains clean and renewable electricity from sea waves, taking advantage of the changes in water level and using a system of floats.

In 2015, she participated in the United Nations Climate Change Conference in Paris and in 2018 she was chosen by CNN as one of tomorrow's heroines. Her work has won several awards for innovation. Almost a century has passed since the death of Hertha Marks and the electrical energy field has evolved a lot thanks, in part, to the work of many researchers such as our protagonists.

QUESTIONS

1 Hertha Marks Ayrton, registered 26 patents as an inventor. Do you know what a patent is? Search for information and write its meaning.

2 Review what you have studied and compare nuclear energy with tidal energy.