



Sequence 10: Storage and transfer of energy



Fiche de synthèse mobilisée (collection en français) :

- Fiche n°10 : Stockage et transfert d'énergie



Sommaire des activités ETLV :

- ACTIVITY 1: Fossil fuels and combustion
- ACTIVITY 2: Energies in the world
- ACTIVITY 3: How much land does it take to power the world?

ACTIVITY 1: Fossil fuels and combustion

DOCUMENT 1: The city of Coal burg

The city of Coal burg (Texas) runs her facilities for a century with only fossil fuels available near the city. The new mayor who cares a lot about the environment wants to turn green and change ways to produce energy in the city but he needs to convince the people. During this sequence you will work as a scientific committee member with the aim to present and convince people of Coal burg to change.



Source: Wikimedia commons

**DOCUMENT 2: Fossil energy sources in United states**

“Fossil energy sources, including oil, coal and natural gas, are non-renewable resources that formed when prehistoric plants and animals died and were gradually buried by layers of rock. Over millions of years, different types of fossil fuels formed -- depending on what combination of organic matter was present, how long it was buried and what temperature and pressure conditions existed as time passed.

Today, fossil fuel industries drill or mine for these energy sources, burn them to produce electricity, or refine them for use as fuel for heating or transportation. Over the past 20 years, nearly three-fourths of human-caused emissions came from the burning of fossil fuels.

The Energy Department maintains emergency petroleum reserves, ensures responsible development of America’s oil and gas resources and executes natural gas regulatory responsibilities. In addition, scientists at the Energy Department’s National Labs are developing technologies to reduce carbon emissions and ensure fossil energy sources play a role in America’s clean energy future.”

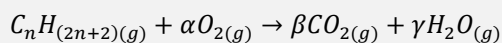


<https://www.energy.gov/science-innovation/energy-sources/fossil>

Source: Wikimedia commons

DOCUMENT 3: Combustion reaction

We can make the hypothesis that fossil energy is made of linear carbon and hydrogen molecules called alkanes. The complete combustion of a $C_nH_{(2n+2)}$ alkane in oxygen O_2 is a chemical reaction producing carbon dioxide CO_2 and water H_2O according to the following equation:

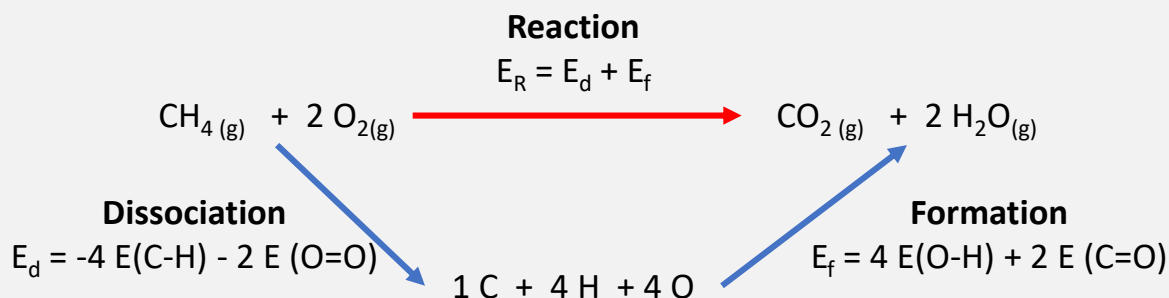


With α, β, γ stoichiometric coefficients to balance the equation

**DOCUMENT 4: Energy of a reaction**

Bond energy (kJ.mol ⁻¹)			
E(C-C)	348	E(O=O)	494
E(C-H)	413	E(H-O)	459
E(H-H)	436	E(C=O)	799

From these average bond energies, it is possible to calculate the reaction energy, it means the heat produced by this reaction. To do this, write the reaction balance equation and count the bonds destroyed and the bonds formed. It is interesting to do this in the form of an energy diagram so that you keep everything in mind. Here is an example:



According to documents answer to the following questions:

1. Give some examples of fossil fuels you can find in the United States.
2. What are advantages and drawbacks of fossil fuels?
3. Write the chemical equation of the combustion of butane (C₄H₁₀(g)).
4. Compute the energy released by the combustion of butane (C₄H₁₀(g)).
5. How can we produce electric energy with the heat of a combustion reaction? Draw an energy chain.
6. Write an essay (100 words) to convince people of Coal burg that they can no longer use fossil fuel.



ACTIVITY 2: Energies in the world

DOCUMENT 5: Wind energy

Wind is produced as a result of giant convection currents in the Earth's atmosphere, which are driven by heat energy from the Sun. This means that the kinetic energy in wind is a renewable energy resource - as long as the Sun exists, the wind will too. Wind turbines use the wind to drive turbines directly. They have huge blades mounted on a tall tower. The blades are connected to a 'nacelle', or housing, which contains gears linked to a generator. As the wind blows, it transfers some of its kinetic energy to the blades, which turn and drive the generator. Several wind turbines may be grouped together in locations to form farms.



<http://acver.fr/wind>

DOCUMENT 6: Solar energy

Solar is the first energy source in the world. Solar energy is mostly used in generating light and heat. It was this energy that is believed to have been responsible for the breaking of ice during the ice age, which creates the separation of lands and sea. Solar energy is the alternative energy source that is used most widely across the globe. While solar energy is used for producing solar energy, it is also used for drying clothes, used by plants during the process of photosynthesis and also used by human beings during winter seasons to make their body temperature warm. Solar energy can be extracted either by Solar Thermal or using Photovoltaic (PV) Cells.



<http://acver.fr/solar>

DOCUMENT 7: Biomass energy

This is the process by which an alternative energy is generated through conversion of biological materials and wastes into forms that can be used as energy sources for heating, power generation and transportation. Biomass energy has been around since ancient times when people used to burn wood or coal to heat their homes or prepare food. Wood still remains the most common source to produce biomass energy. Apart from wood, the other products that are used to create biomass energy include crops, plants, landfills, municipal and industrial waste, trees and agricultural waste.



<http://acver.fr/biomassenergy>

**DOCUMENT 8: Geothermal energy**

Geo' means Earth and 'thermal' means energy. Geothermal energy means energy drawn or harnessed from beneath the earth. It is completely clean and renewable. The earth contains a molten rock called magma. Heat is continuously produced from there. The temperature increases about 3 degrees Celsius, for every 100 meters you go below ground. Below 10,000 meters the temperature is so high, that it can be used to boil water.



<http://acver.fr/geothermal>

DOCUMENT 9: Water energy

Due to massive size of oceans or rivers, hydropower can be used as alternative source of energy. The waves produced by the ocean or the flow of a river have enormous potential in them. If they are harnessed with full capacity they can go a long way in reducing world's energy problems.



<http://acver.fr/hydropower>

DOCUMENT 10: Nuclear energy

Nucleus of an atom contain a lot of energy which can be release by two types of reactions : fission or fusion.



<http://acver.fr/-etlv>

7. According to the previous documents (texts and videos) about renewable energies, find advantages and drawbacks of one type of energy.
8. According to the documents about renewable energies, prepare in groups of three students, a three-minute presentation of one energy that you would give at a Coal burg's public meeting. This presentation must deal with the following points:
 - How does this energy work?
 - Why is it better to use it rather than fossil fuel?
 - Give examples of some related problems related to using this energy.

Don't forget to take notes during all the presentations, it will be useful for the last step.



ACTIVITY 3: How much land does it take to power the world?

DOCUMENT 11: How much land does it take to power the world?



https://www.ted.com/talks/ted_ed_how_much_land_does_it_take_to_power_the_world

9. Watch the video and fill in the chart below:

	Space needed to power a 10 Watt lightbulb	Space needed to power the world 3.10^{12} Watt
Fossil fuel		
Nuclear		
Solar power		
Wind power		

10. Give elements which must be considered for each type of energy described in the video.

11. With all your knowledge about energy, write an article for the *Coal Burg Daily News* (250 words) which argues and gives the best option to produce energy for the city.



Activity summary

What you must remember:

- **Energy of a reaction**
- **Energy transfer**
- **Specific vocabulary:**

English	French
coal	charbon
bond	liaison
green house effect	effet de serre
green house gases	gaz à effet de serre
global warming	réchauffement climatique

English	French
wind turbine	éolienne
solar panels	panneaux solaires
nuclear power plant	centrale nucléaire
light bulb	ampoule

Skills linked to the curriculum:

Compétences	Capacités à maîtriser	Où dans cette séquence ?
APP	Utiliser du vocabulaire spécifique	Activités 1 à 3
	Lire et comprendre des documents scientifiques	Activités 1 à 3
ANA	Mettre en lien des documents pour émettre des hypothèses en réponse à une question scientifique	Activités 1 à 3
COM	S'exprimer à l'écrit en utilisant le vocabulaire adapté	Activités 1 à 3
REA	<ul style="list-style-type: none"> • Déterminer l'énergie libérée par une réaction de combustion • Chaîne énergétique • Identifier les sources d'énergie existantes, leurs avantages et leurs inconvénients • Comprendre les enjeux du mix énergétique 	Activité 1 Activités 1 à 3