



Département d'Enseignement des Langues

# Master 1 Reservoir Geology



Year 2016-17

## Organisation of the semester

This semester, you will have 25 hours of English.

### Objectives

The main objectives will be to :

- study scientific language and vocabulary relating to reservoir geology and mining
- develop reading skills so as to be able to read academic literature during your second year of Master's degree.
- improve your listening
- practise speaking in different situations

### Program

#### 1/ listening

- ▶ watching videos and listening to discussions about your subject of study

#### 2/ reading

- ▶ learning to read specialised texts quickly for key information

#### 3/ speaking

- ▶ discussions and presentations

#### 4/ Writing

- ▶ explaining and discussing written or oral documents

### Assessment

The marks will be the following

|   |    |
|---|----|
| Anatomy of an oil field                   | 20 |
| Scientific debating                       | 20 |
| Final exam (listening/vocabulary/writing) | 20 |

**Total mark                      60**

Your presence is **compulsory** ; all absences must be justified by a medical certificate.

**The language classes are held in Building 5 :**

**Downstairs for classrooms beginning with 0**

**Ground floor for classrooms beginning with 1**

**First floor (near amphi 2) for classrooms beginning with 2**

**Teacher in charge of English :**

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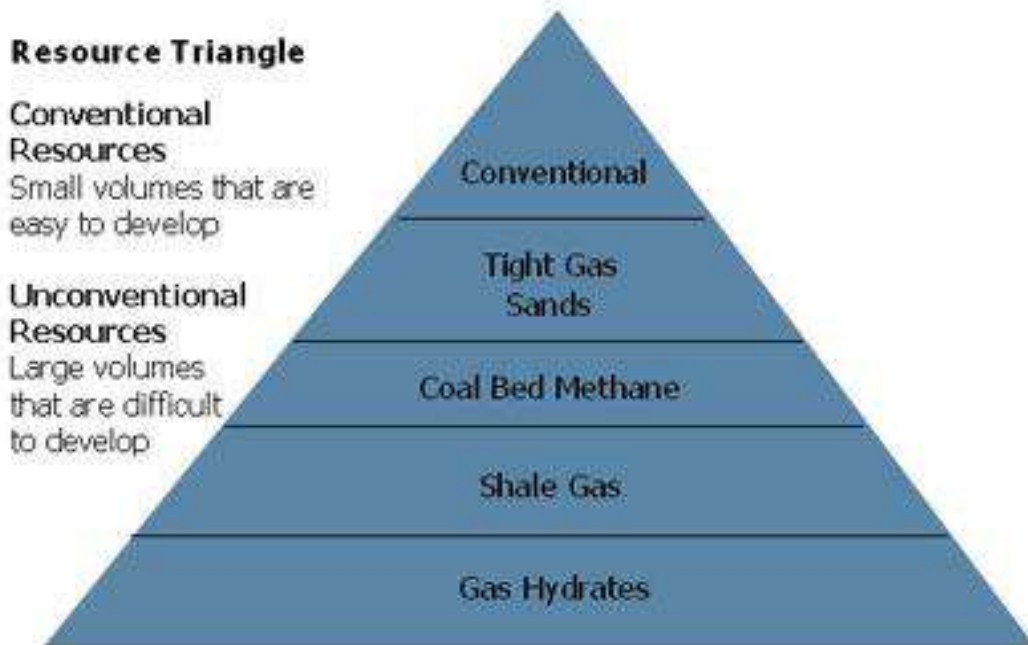
## TYPES OF OIL & GAS

### Natural Gas

- **Natural gas** is a naturally occurring hydrocarbon consisting primarily of methane. It may also contain small amounts of ethane, propane, butane and pentanes.
- Conventional natural gas is easier to produce than unconventional gas, which includes **tight gas**, **coal bed methane**, **shale gas** and gas hydrates (a possible future source).
- Most of the growth in supply from today's recoverable gas resources is found in unconventional formations, made accessible by innovative technologies including horizontal drilling and **hydraulic fracturing**.

### Crude Oil

- Conventional **crude oil** flows relatively easily through a well or pipeline.
- **Heavy oil** is a more dense, viscous oil, with a high proportion of **bitumen**, that is difficult to extract with conventional techniques.
- **Oil sands** are a thick mixture of bitumen, water, sand, heavy metals and clay.
- **Tight oil**, trapped in formations of low porosity and permeability (like shale), requires horizontal drilling and stimulation such as **hydraulic fracturing**.



## 1/ What is tight gas ?

Gas with very low flow rates. Found in sedimentary layers of rock that are cemented together so **tightly** that it greatly "**hinders**" the extraction. Getting tight gas out usually requires **enhanced** technology like "hydraulic fracturing" where fluid is pumped into the ground to make it more permeable.

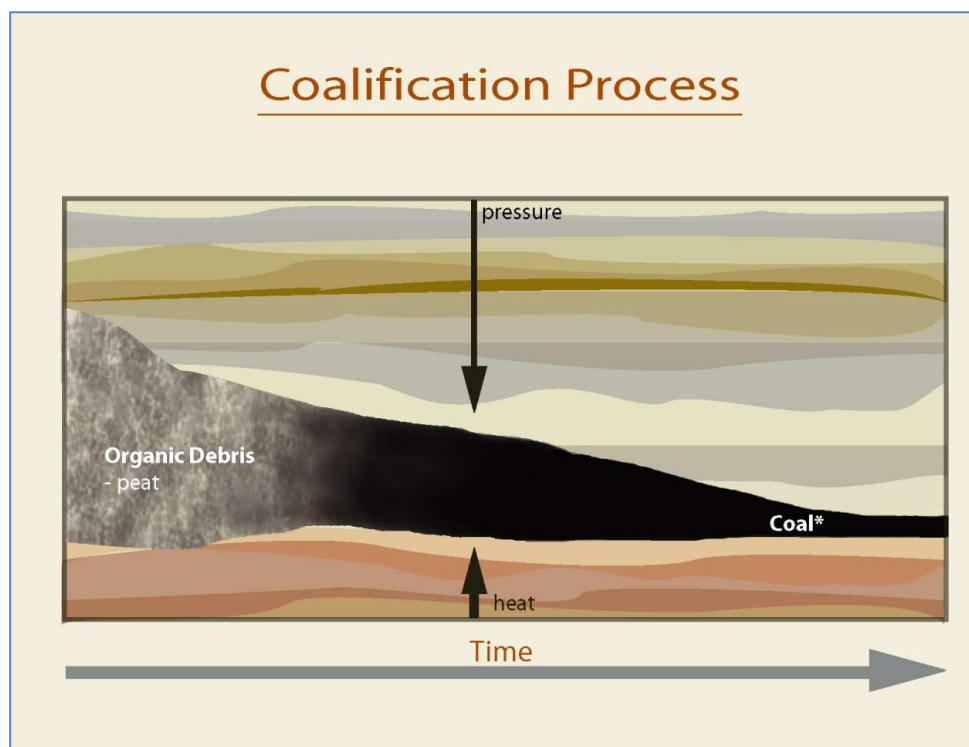
## 2/ How is coalbed methane created ?



When plant material such as roots, **bark**, and wood are deposited in **swamps** or swampy lakes, they undergo bacterial and chemical changes to make **peat** deposits. As the peat is buried deeper, under layers of sand and mud, over millions of years, it changes to brown coal, then bituminous coal, and eventually hard, anthracite coal (*coalification process*).

As the coal is formed, the decomposing organic material produces methane gas, as well as nitrogen, carbon dioxide, and other gases. The **burial** process puts pressure on the coal, which keeps much of the gas in the coal. Like natural gas from conventional sources, CBM is "sweet" not "**sour**" as it doesn't contain hydrogen sulphide. CBM is an unconventional gas as the gas is contained in difficult-to-produce reservoirs, which require special **completion**, stimulation and/or production techniques to **achieve** economic production. The coal remains in place after the CBM is removed.

CBM is extracted by drilling a well into a **coal seam** applying similar techniques used for other natural gas wells. The sides of the well are "cased" with cemented steel pipe. Usually, small holes, called perforations, are then made in the wall of the casing to let the CBM flow through into the **well bore** and up the casing to the surface. In some cases the wells are drilled horizontally and the coal seams are often stimulated or "fractured" to make the CBM flow more freely. Standard drilling and extraction technology is used or adapted as conditions require.



→ Time for practice Match the definitions and the words in bold in the text :

1. a coal seam

2. a swamp :

3. a well bore

4. bark :

5. completion :

6. peat :

7. sour :

8. tightly :

9. to achieve :

10. to bury (a burial) :

11. to enhance :

12. to hinder :

A. a compact brownish deposit of partially decomposed vegetable matter saturated with water: used as a fuel (when dried) and as a fertilizer

B. a hole in the ground, esp. one drilled in search of minerals, oil, etc

C. a protective layer of dead cells on the outside of trees

D. a stratum of ore (i.e coal here)

E. an area of very wet land with wild plants growing in it

F. finalization, fulfilment

G. has a sharp, unpleasant taste like the taste of a lemon

H. in a close manner, firmly and securely

I. to bring to a successful conclusion; accomplish

J. to intensify or increase in quality, to improve

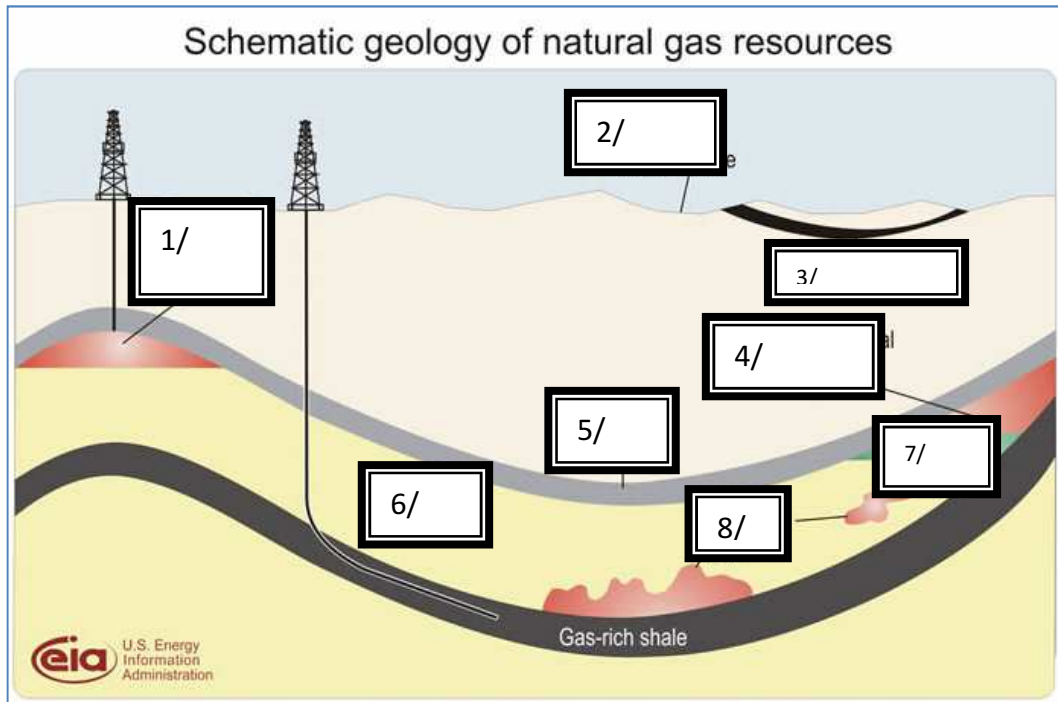
K. to prevent, to obstruct

L. to put something/someone into a hole in the ground and cover it up with earth



→ Time for practice Place the following words on the diagram labels :

tight sand gas      land surface      CBM      sandstone      oil  
 seal      conventional associated gas      conventional non associated gas





### 3/ What is Shale Gas?

Shale gas is natural gas, no different than what you currently use to heat your home or cook with or use to generate electricity. The gas is naturally trapped within very fine grained sedimentary rocks called shale or mudstone. Millions of years ago, the mud and silt that was deposited in ancient oceans and lakes often contained plant and animal debris. Over time, these sediments containing the organic material, were compacted and solidified through burial. With increasing temperature and pressure they formed shale and mudstone. The organic material through the same pressure and temperature processes generated oil and gas which in many cases migrated into other rock types such as sandstones and limestones to form conventional oil and gas reservoirs. The natural gas that is retained within the shale is referred to as shale gas

Shale and mud rich rocks often vary in colour as well as grain size. Colours may vary from dark brown or grey through to black shale, like the Utica Formation in Quebec or the shales of the Horn River Basin in British Columbia. In some basins, often the fine grained shale rocks are interbedded with coarser grained siltstones. Where structural processes have been at work, the shale rocks can be fractured creating natural pathways for natural gas or oil to flow to the wellbore.

#### How is Natural Gas Stored in Shale?

Shale rocks contain very fine grains of minerals separated by very small spaces called "pores". Natural gas or oil molecules that have been created from the organic material in the rock are trapped within the numerous micro-pores or are attached to the organic material by a process called adsorption. The amount of pore space within the shale usually ranges between 2-10% allowing a large volume of natural gas to be stored within the rock. The amount of natural gas that is stored within shale is variable depending on the amount of open pore space, amount of organic material present, reservoir pressure and thermal maturity of the rock. Thermal maturity is a measure of how much pressure and temperature the rock has been subjected to. It also measures whether oil or gas has been generated during the process. Core samples are often collected to allow laboratory tests to be taken that will measure the amount of organic material present as well as the thermal maturity.

#### → Time for practice Justify from the text whether these statements are true or false

1/ Shale gas is a processed source of energy.

- True                       False
- .....

2/ Human fragments were trapped into shale deposits.

- True                       False
- .....

3/ Shale rocks display a wide range of thicknesses.

- True                       False
- .....

4/ Shale gas results from oil and gas accumulation in the rocks.

- True                       False
- .....

5/ The quantity of gas generated is closely linked to climate variations.

- True                       False
- .....

6/ Drilling companies will set to recover shale gas whenever a promising formation is spotted.

- True                       False
- .....

#### 4/ Oil : a few definitions

→ Time for practice Fill in the gaps with the right words :

|           |          |            |          |        |        |
|-----------|----------|------------|----------|--------|--------|
| below     | bitumen  | deeper     | further  | lie    | little |
| producers | slightly | technology | underlie | within |        |

**Conventional crude oil** : Petroleum found in liquid form, flowing naturally or capable of being pumped without \_\_\_\_\_ processing or dilution.

**Heavy crude oil** : Oil with a gravity \_\_\_\_\_ 28 degrees API.

**Oil sands** are a mixture of sand, water, clay and \_\_\_\_\_.

**Bitumen** is oil that is too heavy or thick to flow or be pumped without being diluted or heated. At 10° C/50° F, bitumen is hard as a hockey puck. Some bitumen is found \_\_\_\_\_ 70 metres (200 feet) of the surface, but the majority is \_\_\_\_\_ underground. Bitumen is so viscous that at room temperature it acts much like cold molasses. A variety of treatment methods are currently available to oil sands \_\_\_\_\_ and new methods are put into practice as more research is completed and new \_\_\_\_\_ is developed.

Oil sand can be found in several locations around the globe, including Venezuela, the United States and Russia, but the Athabasca deposit in Alberta is the largest, most developed and utilizes the most technologically advanced production processes. Alberta's oil sands \_\_\_\_\_ under 142,000 km<sup>2</sup> of land (54,800 mi<sup>2</sup>). Only about three per cent, or 4,800 km<sup>2</sup> (1,850 mi<sup>2</sup>), of that land could ever be impacted by the mining method of extracting oil sands. The remaining reserves that \_\_\_\_\_ 97 per cent of the oil sands surface area are recoverable only by in-situ (drilling) methods, which require very \_\_\_\_\_ surface land disturbance. The oil sands area actively being mined is 895 km<sup>2</sup> (346 mi<sup>2</sup>), an area \_\_\_\_\_ larger than the City of Calgary.



→ Time for practice Act up a dialogue between an oil expert and a journalist, finding suitable questions and answers. (Any theatrical tendencies are strongly encouraged !)

### **Oil sands or tar sands?**

Historically, oil sand was incorrectly referred to as tar sand due to the now outdated and largely ineffective practice of using it for roofing and paving tar (oil sand will not harden suitably for these purposes). Though they appear to be visibly similar, tar and oil sands are different; while oil sand is a naturally occurring petrochemical, tar is a synthetically produced substance that is largely the last waste product of the destructive degradation of hydrocarbons. Furthermore, their uses are completely different: oil sand can be refined to make oil and ultimately fuel, while tar cannot and has historically been used to seal wood and rope against moisture.

**Expert Q & As :**

### **What is Tight Oil?**

Crude oil, also known as petroleum or fossil fuel, is found in some rock formations deep below the earth's surface. Crude oil forms the foundation for the petroleum industry and is relied upon for fuels as well as feed stocks for the petrochemical industry. Oil is commonly defined as either heavy or medium-to-light grade dependent on the density of the hydrocarbon and its ability to flow. Heavy oil generally refers to crude oil that is too viscous for pipeline transport without dilution, or oil that is mined in the oil sands in Northern Alberta. Conventional oil, which is referred to as light or medium in grade, is found in reservoir rocks which have enough permeability (the ability for a fluid to move through a rock formation) to allow the oil to flow to a vertical or horizontal well. Tight oil is conventional oil that is found within reservoirs with very low permeability. The oil contained within these reservoir rocks typically will not flow to the wellbore at economic rates without assistance from technologically advanced drilling and completion processes. Commonly, horizontal drilling coupled with multi-stage fracturing is used to access these difficult to produce reservoirs.

**Expert Q & As :**

### **How is the Oil Stored and Released from the Rock?**

Oil is trapped within the open spaces in the rock (called porosity). This porosity may be in the form of the small spaces between grains in a sandstone or as small, open vugs, or cavities, within carbonates (limestone or dolomite type rocks). For the reservoir to flow oil to a wellbore, the rock must have some form of permeability either in interconnected pathways between pore spaces or in natural fractures found in the rock. The percentage of pore volume, or void space, within the rock is generally less than 30% and in tight oil reservoirs is commonly less than 10%. The amount of oil stored within a reservoir is directly related to the porosity of the reservoir and other geological characteristics.

**Expert Q & As :**

### **What kind of Oil is Produced from a Tight Oil Reservoir?**

Crude oil has a number of characteristics or properties that allow it to be classified into different types. One of the main properties of oil is its density. The higher the density, the more resistant it is to flowing in the reservoir. A measure of a fluid's resistance to flow is termed viscosity. Most tight oil produced is of the medium to light variety, with a lower viscosity.

### **Why Explore for and Produce Tight Oil?**

The world has relied extensively on the production of oil for many years and continues to be dependent on it as the primary source of transportation fuels. As countries continue to produce oil resources, there is a natural decline in production as the easy to access resources are depleted. Essentially, our conventional oil and gas resources are like low hanging fruit; produced utilizing existing technology such as vertical wells and small scale stimulations. Extensive oil and gas resources are known to be present in tight oil reservoirs, however, they require additional technology to enable them to be produced. Tight oil is of high quality but commonly found in regions where reservoir properties inhibit production using conventional drilling and completion techniques. The oil itself requires very little refinement and, in many cases, existing surface infrastructure can often be utilized, reducing both surface impact and capital investment.

### **Expert Q & As :**

## **Digging Deeper: Get the Facts on Hydraulic Fracturing**

The hydraulic fracturing process begins with drilling a well to reach the rock formations that are typically found 2 to 3 kms below the earth surface. As the drillbit moves down, drilling fluid is pumped into the wellbore to lubricate and cool the bed while transporting cuttings to the surface at the same time. Steel casing is inserted and cemented in place along the way, creating a solid barrier between the well and any underground fresh water sources. Drilling continues far below where the drillbit is steered horizontally through the natural gas or tight oil formation. At the well's final depth, another layer of casing is secured throughout the full length of the wellbore.

Hydraulic fracturing begins once the drilling process is completed. While the drilling process typically takes about a month for a single well, hydraulic fracturing of a single well can be completed in roughly half that time. The first step is to perforate the wellbore casing that lies horizontally in the shale formation. These perforations allow fracturing fluid pump down the well under pressure to reach the reservoir rock and create fractures. These fractures usually extend between 50 and 150 m from the horizontal leg of the wellbore.

By its very nature this process induces managing microseismicity to fracture the rock. The seismic activity is rarely felt on the surface. In fact science says that hydraulic fracturing poses no serious risk. A fracturing fluid is a mixture made up of 98.5% of water and sand, with the remainder comprised of additives, many of which are found in household products. These additives are used to reduce friction in the wellbore.

In addition to adhering to Canada's strict regulatory guidelines, industry supports full disclosure of fracturing fluid additives. The sand props open the fracture in order to provide a pathway for the natural gas or the tight oil to flow into the wellbore more easily. Once hydraulic fracturing is completed, all fracturing equipment is removed and the wells can then produce up to 30 years without having to be hydraulically fractured again. A completed single well site can even take up less space than a type residential two-place garage.

## Digging Deeper: Get the Facts on Hydraulic Fracturing

### 1/ Fill in the gaps :

The hydraulic fracturing process begins with drilling a well to reach the rock formations that are \_\_\_\_\_ found 2 to 3 kms below the earth surface. As the drillbit moves down, drilling \_\_\_\_\_ is pumped into the wellbore to lubricate and cool the bed while transporting \_\_\_\_\_ to the surface at the same time. \_\_\_\_\_ casing is inserted and \_\_\_\_\_ in place along the way, creating a solid \_\_\_\_\_ between the well and any underground fresh water sources. Drilling continues far below where the drillbit is steered \_\_\_\_\_ through the natural gas or tight oil formation. At the well's final depth, another layer of casing is secured \_\_\_\_\_ the full length of the wellbore.

### 2/ Answer the comprehension questions :

- a) *How long does an average drilling process take ?*
- b) *What about hydraulic fracturing of a single well ?*
- c) *What are perforations useful for ?*
- d) *How far from the horizontal leg of the well bore do the fractures extend ?*
- e) *What does the process induce ?*
- f) *Explain the following terms :*
  - a fracturing fluid :
  - regulatory guidelines :
- g) *Detail Stage 3 = completion*

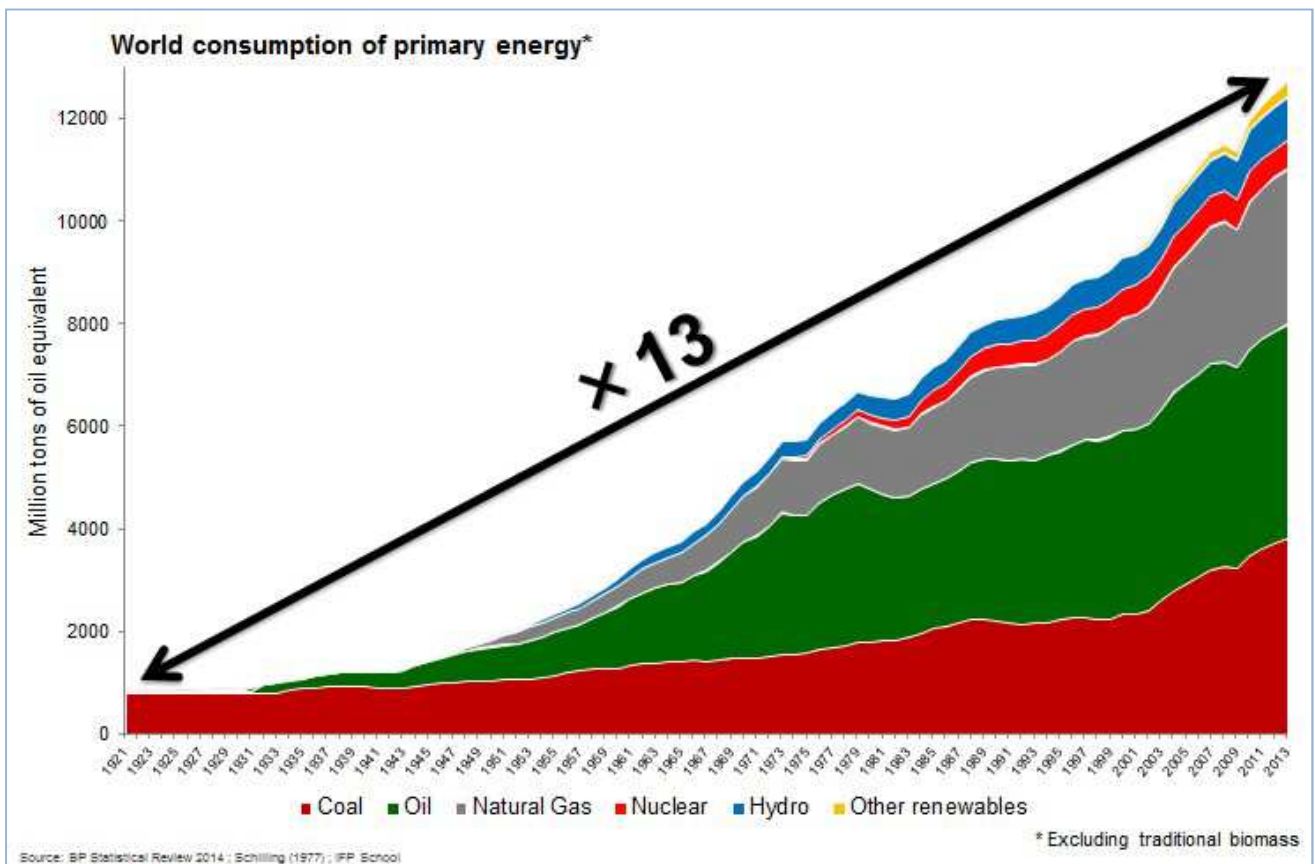


## Oil and gas : the energy scene

*Why are the oil and natural gas energies dominant in the global energy mix today ? Will they remain our main resources in the years to come ?*

### Energy consumption growth

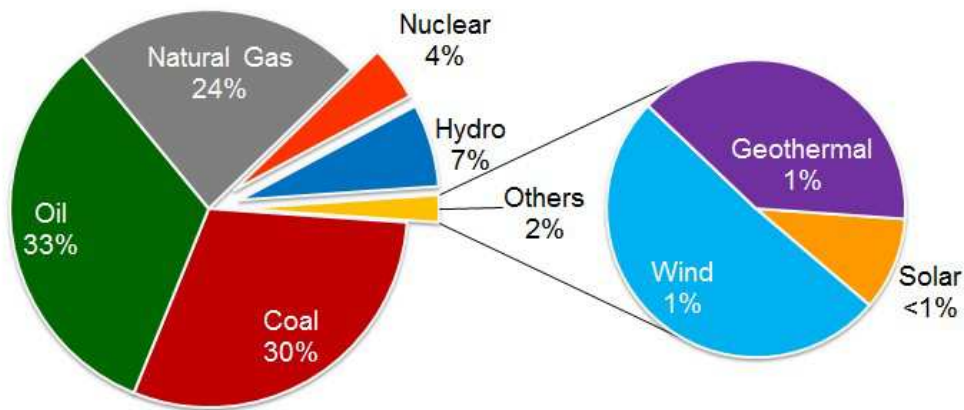
Human development is closely linked to energy consumption. If we observe what happened during the last century, population, economic wealth and energy consumption grew almost without any interruption, one influencing the others, and vice-versa. Global population was 1.6 billion in nineteen hundred (1900), 2.5 billion fifty years later, and we are more than 7 billion human beings today. Wealth, estimated by the gross domestic product in real value, has been multiplied by a factor of 40 over the same period .



**Comment on the above graph :**

## Oil & natural gas in today's energy mix

How is the energy mix shaped today?

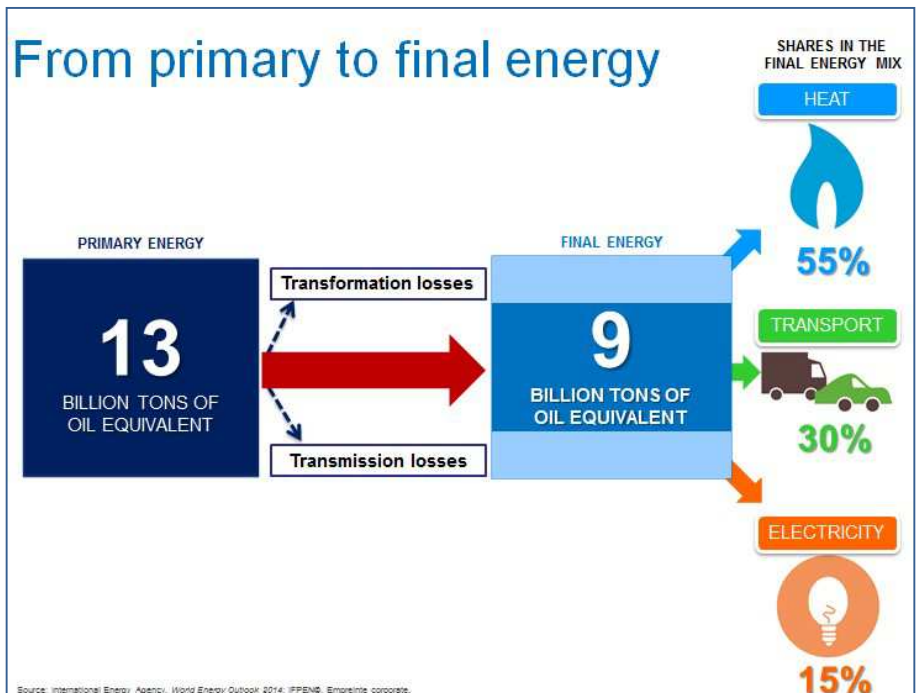


**Comment on the above pie charts :**

But the primary energy, the energy as found in nature, needs to be processed, and transported before being available for end-users. From the 13 billion tons of oil equivalent of primary energy, we get only 9 billion tons in final energy, after withdrawing transformation and transmission losses.

Fossil resources remain dominant in the mix, because so far, they appear to be the most economic and efficient energy sources for our main uses. Heat, that accounts for more than half of our needs, is mainly satisfied by oil or natural gas. Transport, which is almost one third of the global energy demand relies almost entirely on oil, while coal is the main source for electricity, which represents 15% of the final energy consumption.

### From primary to final energy

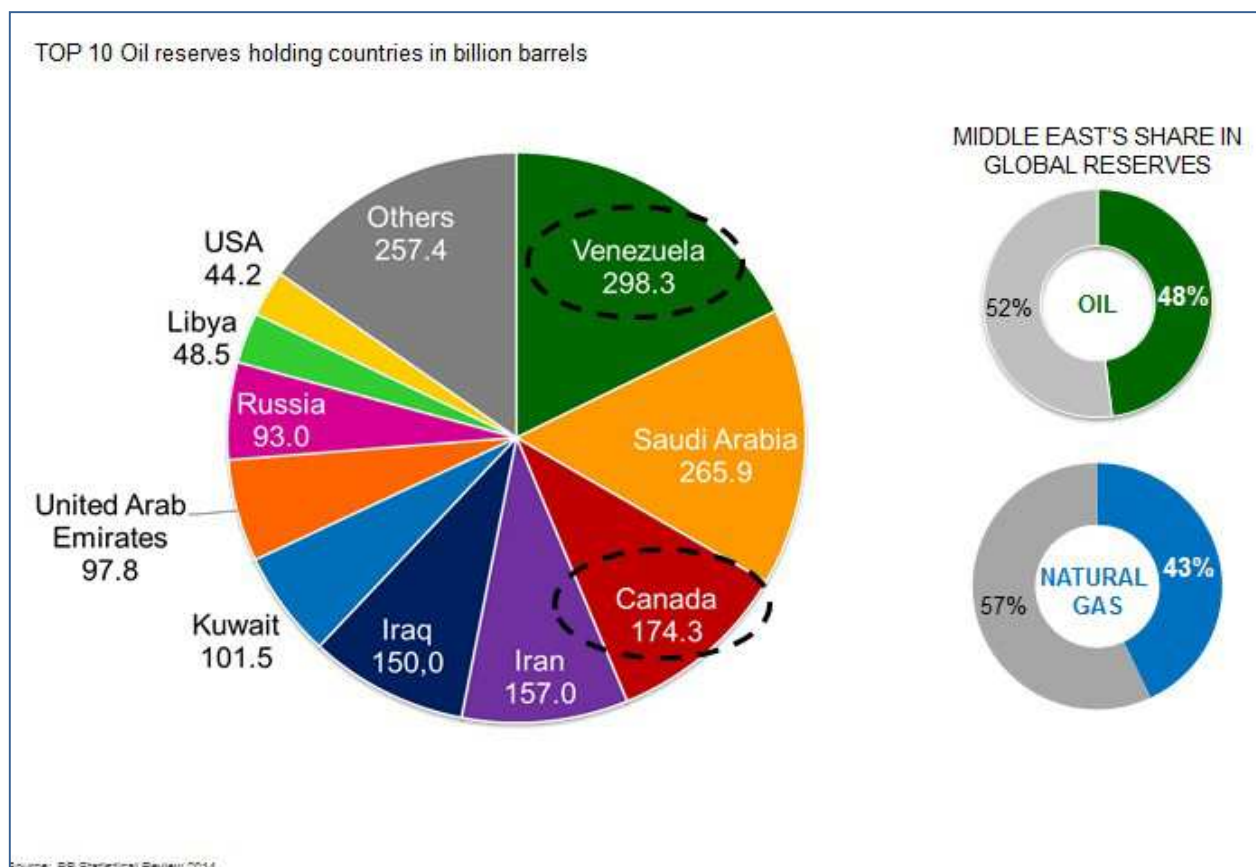


## Reserves, production & consumption

And fossil resources are here to stay in the future. Based on our current consumption, proven oil reserves can still satisfy our needs for the next 53 years, natural gas for 55. In the meantime, new discoveries are made every day, pushing back the often predicted, but yet to be seen, end of fossil fuels.

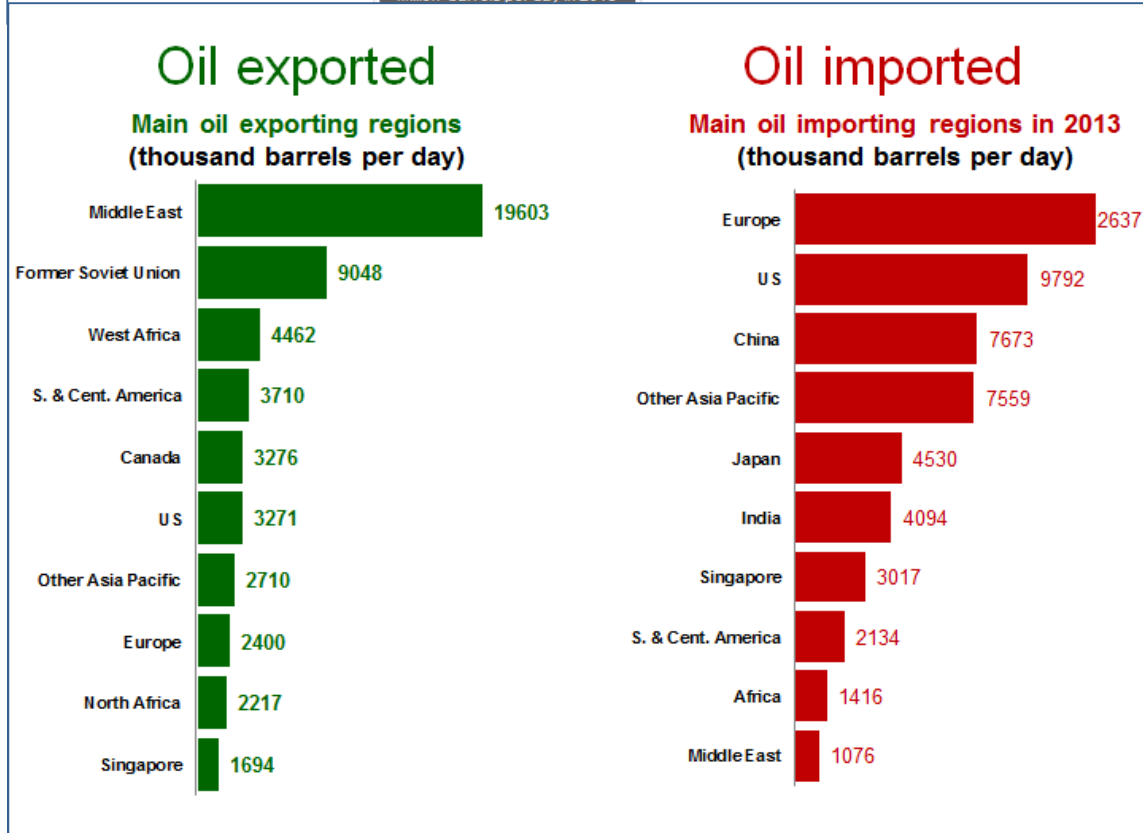
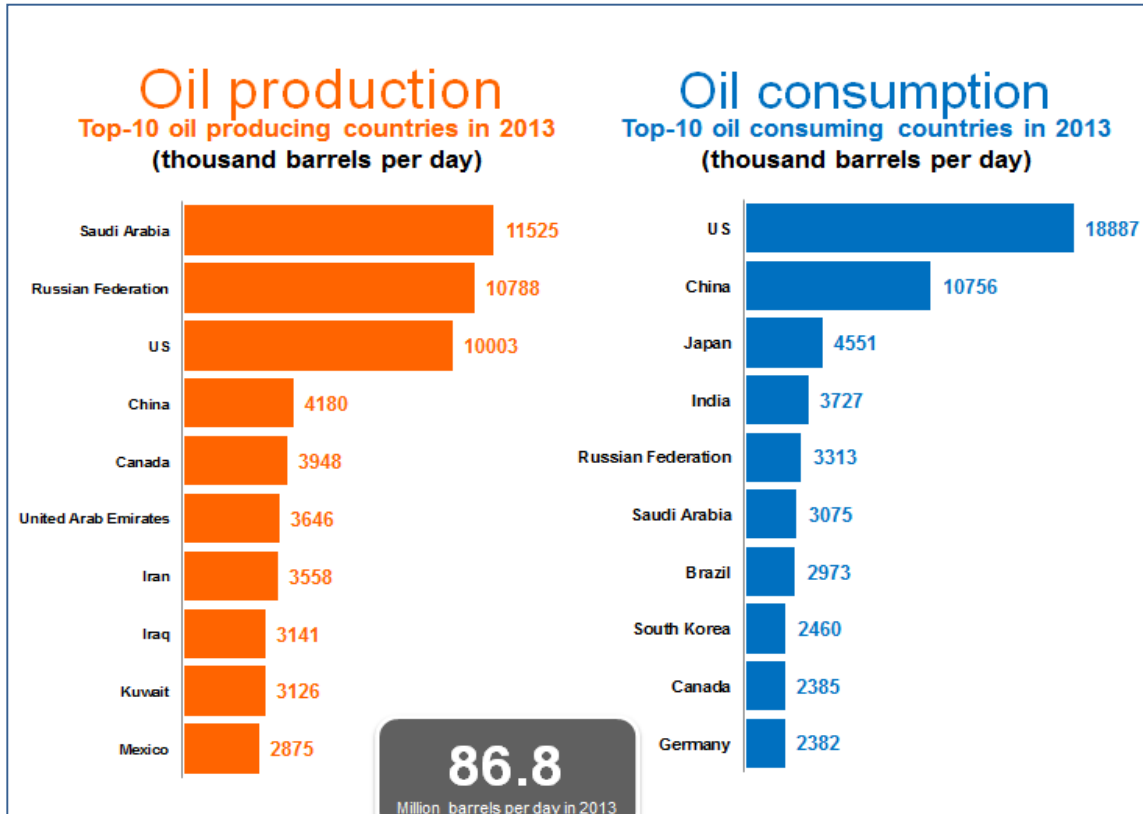
What may be coming to an end however is the “easy oil”. By easy oil, we mean the reserves easy to find, easy to extract from the ground and easy to transform into ready-to-consume products. Since the mid-20th century, the most important oil and natural gas reserves have been discovered in 1\_\_\_\_\_. This region, led by 2\_\_\_\_\_, 3\_\_\_\_\_, 4\_\_\_\_\_, 5\_\_\_\_\_ and the UAE represents almost half of the world’s proven oil reserves. For natural gas, notably thanks to 2\_\_\_\_\_ and 6\_\_\_\_\_, 1\_\_\_\_\_ holds 43% of the global reserves.

But for countries such as 7\_\_\_\_\_ and 8\_\_\_\_\_, reserves have been recently re-assessed and have increased dramatically. They now rank first and third for proven oil reserves. The most recent oil discoveries have been made in unfamiliar locations. For instance in 9\_\_\_\_\_ with ultra-deep offshore pre-salt reservoirs, or in Northern America with tight-oil regions. During the last 5 years, almost 30% of the global oil & gas discoveries have been made in 10\_\_\_\_\_. The oil price increase in the past decade and the development of new extraction techniques have made some resources profitable to produce, changing the overall reserves landscape.



## Energy trade flows

But holding reserves is not what fuels our economies. It is the oil & natural gas extracted from the ground and effectively produced that does. Once a field has been discovered, economists assess the expected profitability of the project, based on the cost of development, estimated by engineers, and on scenarios of oil price over the lifetime of the project. The largest reserve-holders are not necessarily the largest producing countries.



# WORKPLACE



## Working at Chevron

1/ What does Julia Bagg's job at Chevron consist in ?

2/ What is the purpose of her talk ?



3/ Fill in the gaps :

Oil and 1\_\_\_\_\_ gas are normally found in what we call  
2\_\_\_\_\_ rocks. These are rocks, including 3\_\_\_\_\_, that are  
uniquely suited to 4\_\_\_\_\_ oil and 1\_\_\_\_\_ gas between each of  
the 5\_\_\_\_\_ of sand in the rock. There're all these little pore  
6\_\_\_\_\_, kind of like the pores in your skin, or in a 7\_\_\_\_\_, that can  
4\_\_\_\_\_ onto these little 8\_\_\_\_\_ molecules.  
To find the 2\_\_\_\_\_, we use 9\_\_\_\_\_ technology. We can send  
sound 10\_\_\_\_\_ deep into the 11\_\_\_\_\_ and listen to them when  
they 12\_\_\_\_\_ back up using little, 8\_\_\_\_\_ things called  
geophones. They're basically electronic 13\_\_\_\_\_ that 14\_\_\_\_\_ a  
15\_\_\_\_\_ when they hear the sound come back. The 15\_\_\_\_\_ that  
we get out of them actually looks like this. It looks like a squiggle.  
If we put thousands of these squiggles together in a line, then we have a  
16\_\_\_\_\_ or a 17\_\_\_\_\_ - \_\_\_\_\_ of the  
11\_\_\_\_\_ that we can actually see 18\_\_\_\_\_ in.

4/ List the different jobs related to geology mentioned by Julia and the adjectives used to qualify them :

5/ What are they in charge of ?

6/ What happens once this work is done ?

7/ How much success rate do they expect ? .....%

8/ Why is it a pretty good figure ?

# People and jobs

① Read the information and match words 1-4 to speech bubbles A-D :

1 : **geophysicist**

2 : **lab technician**

3 : **production engineer**

4 : **roughneck**

**A/** I work in the downstream sector of the industry in a refinery. We manufacture a wide range of products for domestic and industrial uses, such as lubricants, bitumen, liquefied petroleum gas (LPG) and petrochemicals

**B/** I work on an offshore oil rig. I spend a lot of my time tripping drill pipe in and out of the hole, and operating the tongs to make the break connections. I also do other jobs around the rig, such as looking after equipment.

**C/** I look at seismic data and help the company make decisions about where to drill. At the moment we are looking a a shale gas reservoir in the USA. Shale gas is natural gas found in shale formations.

**D/** I work for an E&P independent. I'm part of a team of people responsible for the operation, production and maintenance of different facilities in this area. My main job is to find the best way to bring the oil to the surface.

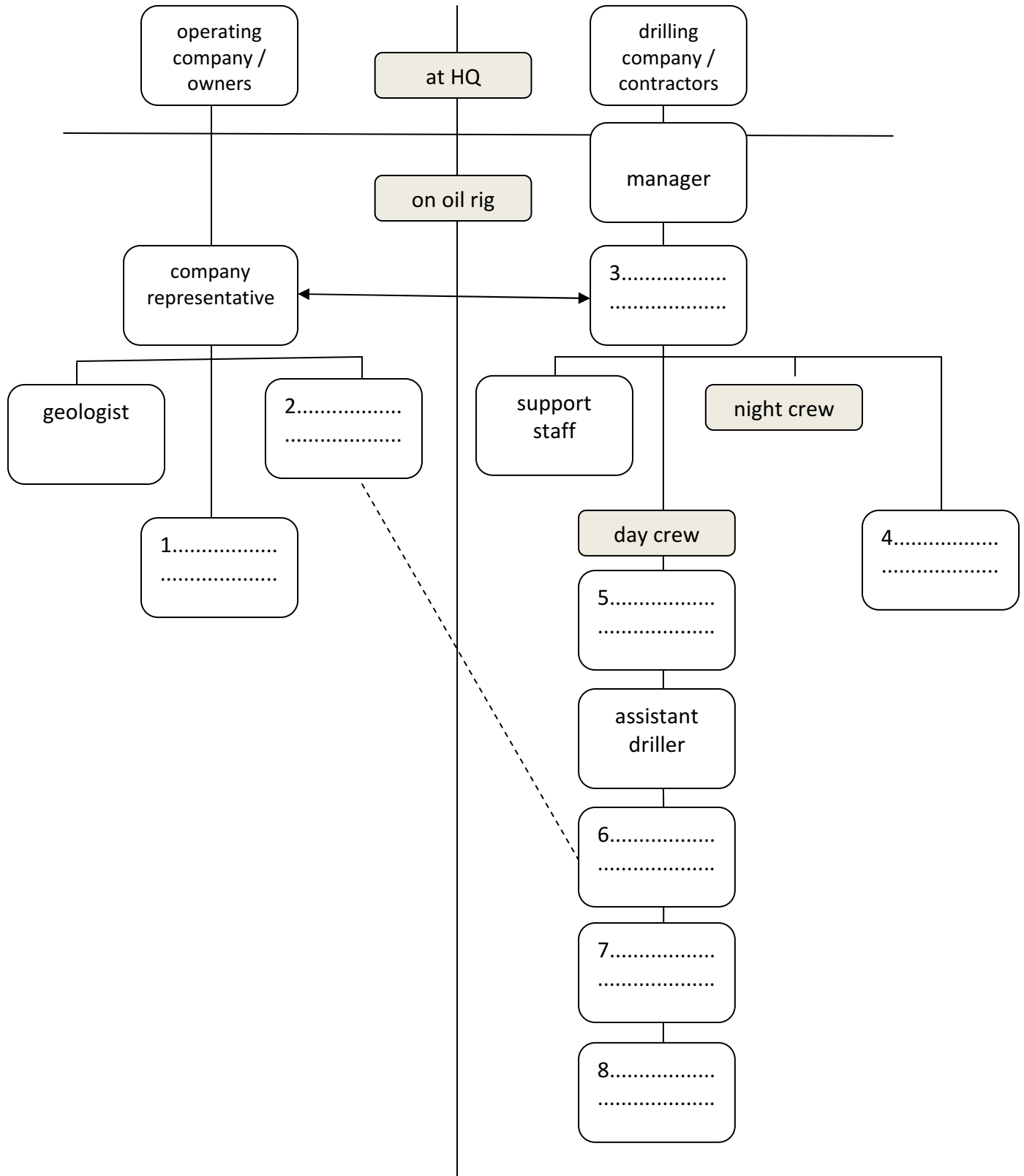
② Match words 1-6 to definitions a-f :

|   |                   |   |   |
|---|-------------------|---|---|
| 1 | downstream sector | a | put a pipe in / pull a pipe out of a drill hole                     |
| 2 | LPG               | b | activities to do with refining, transportation, sales and marketing |
| 3 | trip in/out       | c | connected with earth vibration                                      |
| 4 | E&P independent   | d | independent exploration and production company                      |
| 5 | seismic           | e | liquefied petroleum gas   |
| 6 | shale gas         | f | natural gas found in a type of sedimentary rock                     |

③ Listen to four conversations. Are these statements true (☑) or false (☒) ?

|  |  |
|--|--|
| <p><b>Conversation 1</b></p> <p>Lab technicians mix oils and additives. ☐</p> <p>Customers come to the refinery and pump oil from the storage tanks. ☐</p>     | <p><b>Conversation 2</b></p> <p>Roustabouts don't work in the rain. ☐</p> <p>Roustabouts work alone. ☐</p>                 |
| <p><b>Conversation 3</b></p> <p>Production engineers work in offices all day. ☐</p> <p>Production engineers have to follow health and safety procedures. ☐</p> | <p><b>Conversation 4</b></p> <p>The layers of rock reflect shock waves. ☐</p> <p>Geophysicists analyse seismic data. ☐</p> |

④ Complete this organisation chart with the job titles in the box. You will find the necessary information in the text "A guide to jobs on an oil rig".





## ***A guide to jobs on an oil rig***

### **Employees of the exploration or operating company**

**Company representative** : work for the operating or exploration company. Can give instructions to the toolpusher but does not directly supervise the toolpusher or the drilling crews.

**Drilling engineer** : specialises in the technical aspects of drilling. Reports to the company representative.

**Mud/Drilling fluids engineer** : responsible for the drilling fluid. Reports to the company representative.

### **Employees of the drilling company contractors**

**Toolpusher** : manages the drilling crews on the rig and the support staff. Can receive instructions from the company representative but reports to the manager of the drilling contractor company.

**Driller** : supervises a drilling crew. Controls the rig's machinery during the drilling operation. Has an assistant driller.

**Roughnecks** : skilled workers on the floor of the rig. Operate the tongs to make up and break out drill strings. Also trip pipe in and out of the well hole. Report to the derrickhand.

**Derrickhand** : handles the top of the drill string when the crew are tripping it in or out of the well hole. Also responsible for the flow of drilling fluid into and out of the well hole. Reports to the assistant driller and works closely with the mud engineer.

**Roustabouts** : semi-skilled workers. Do most of the painting and cleaning jobs on the rig. Report to the roughnecks.

**Motorhands** : responsible for the maintenance and operation of drilling engines and motors. Acts as a mechanic and electrician. Reports to the toolpusher.

⑤ **Listen to Abdul as he introduces Harish to the rig crew.**

a) What is Harish's job ?

b) Where will he work

c) Find the job titles corresponding to the following names :

- Mr J :  
.....
- John :  
.....
- Mohammed  
.....
- Ali :  
.....
- Samir :  
.....

## Case study : Madranaa and the oil curse paradox

Oil has been discovered on the tropical island of Madranaa. It is a small reserve that can be exploited for fifteen years. The oil is in the north part of the island near Desperation Bay and the town of Newport. The island is divided by mountains and rainforest. The only way of getting to the south side of the island is by small plane or boat. The biggest town, Alban, is on the south coast. Its



nearby beaches are beautiful and there is a coral reef that is perfect for diving. The island's population of 80,000 people are mostly fishermen or farmers. Some primitive tribes live in the rainforest. The rainforest is home to some rare wildlife. Madranaa is home to some rare wildlife. Madranaa has been described a tropical paradise but life is hard.

- Over half of the population is under twenty.
- There are five doctors for the whole population. There is a very small hospital in Alban.
- Boys go to school at the age of twelve.
- Men live for 50 years and women 40.
- One child in three dies below the age of five.
- Malaria is a big problem.

Relations with Madranaa's larger neighbor Kasmara are difficult. Kasmara's president says that Madranaa belongs to them. Many Kasmarans believe they should share the oil. Kasmaran pirates often attack fishing boats and small villages.

***A/ In subgroups (4-5 students), discuss what Madranaa can do to improve the lives of its people.***

***B/ The Grand Council of Madranaa has to decide how to spend the money from oil. Over the next three years it will have \$200 million to spend. Work in groups and decide how to spend the money ; don't forget you will have to justify your choices !***

***C/ Elect one spokesperson who will present your decisions to the rest of the class.***

|   |                |
|---|----------------|
| International airport                       | \$40 m         |
| modern fishing boats                        | \$20 m         |
| fish processing factory                     | \$10 m         |
| international conference centre             | \$10 m         |
| tourist hotels                              | \$40 m         |
| foreign embassies                           | \$20 m         |
| modern housing                              | \$20 m         |
| coastal road                                | \$50 m         |
| small modern army                           | \$60 m         |
| police force                                | \$10 m         |
| palaces for royal family and prime minister | \$20 m         |
| small navy with gun boats against pirates   | \$30 m         |
| national TV channel                         | \$10 m         |
| schools                                     | \$20 m         |
| university                                  | \$ 20 m        |
| deep-water port                             | \$ 30 m        |
| farming and agriculture                     | \$ 20 m        |
| hospital                                    | \$ 40 m        |
| environmental protection                    | \$ 30 m        |
| <b>Total</b>                                | <b>\$500 m</b> |



The **resource curse**, also known as the **paradox of plenty**, refers to the paradox that countries and regions with an abundance of natural resources, specifically non-renewable resources like minerals and fuels, tend to have less economic growth and worse development outcomes than countries with fewer natural resources.

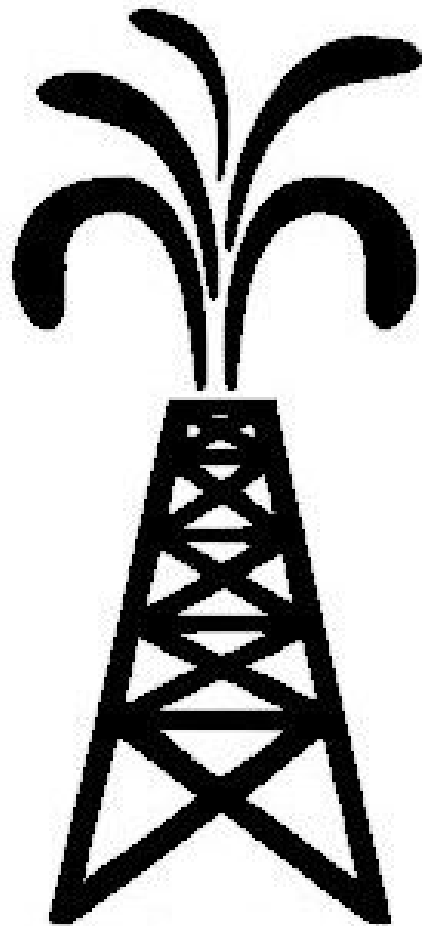
### Resource curse thesis

The idea that natural resources might be more an economic curse than a blessing began to emerge in the 1980s. The term *resource curse thesis* was first used by Richard Auty in 1993 to describe how countries rich in natural resources were unable to use that wealth to boost their economies and how, counter-intuitively, these countries had lower economic growth than countries without an abundance of natural resources.

The negative effects and causes may include :

- internal conflict
- excessive borrowing / taxation
- corruption....

**OIL OIL OIL EVERYWHERE...**



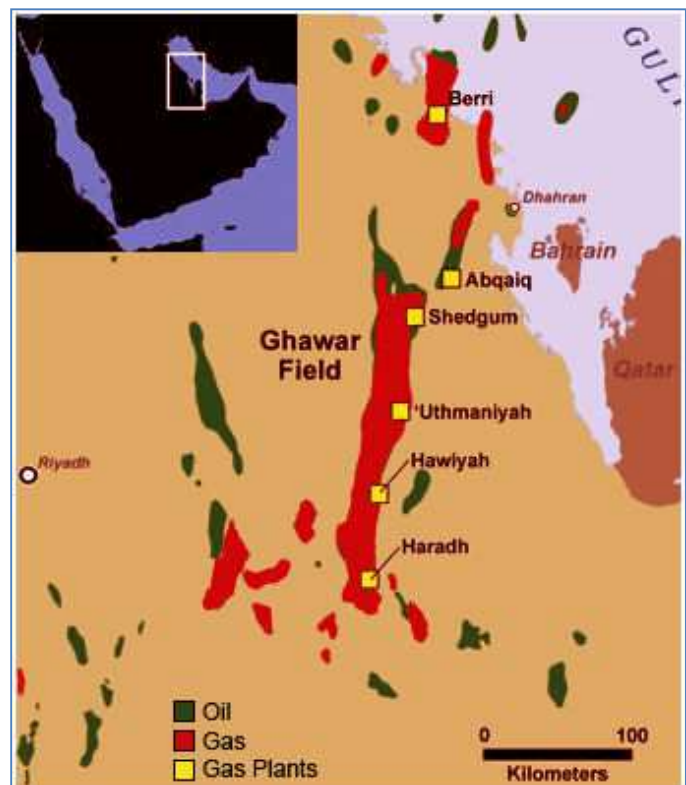
## Anatomy of an oil and gas field

**Here is a geological description of one of the world's major oilfields :**

Ghawar is an oilfield in Saudi Arabia. It is located about 100 km (62 miles) WSW from the city of Dhahran in Al-Ahsa county of the Eastern Province.

Measuring 280 km x 30 km (170 miles x 19 miles), it is by far the largest conventional oilfield in the world. The field is entirely owned and operated by Saudi Aramco, the nationalized Saudi oil company.

Ghawar occupies an anticline above a basement fault block dating to Carboniferous time, about 320 million years ago ; Cretaceous tectonic activity, as the north-east margin of Africa began to impinge on south-west Asia, enhanced the structure. Reservoir rocks are Jurassic Arab-D limestones with exceptional porosity (as much as 35% of the rock in places) sourced from the Jurassic Hanifa formation, a marine shelf deposit of mud



and lime with as much as 5% organic material (1% to 2% is considered good oil source rock). The seal is an evaporitic package of rocks including impermeable anhydrite.

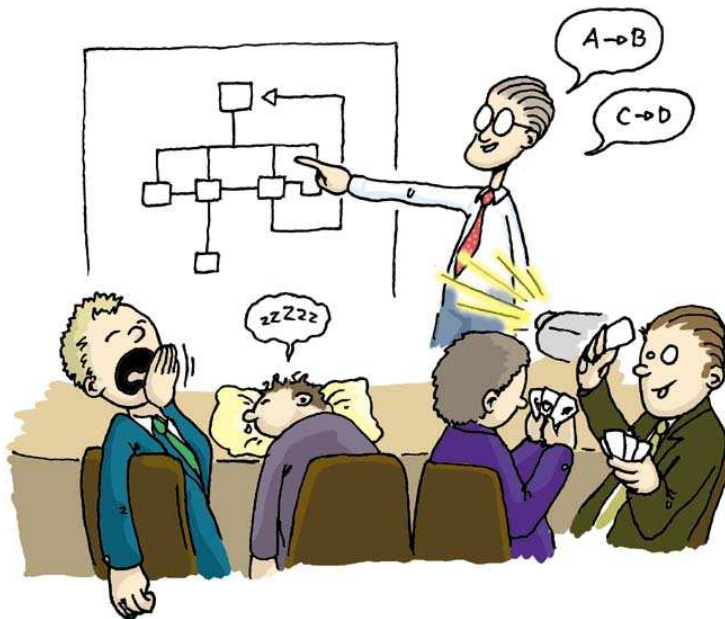
# Presentation

Prepare your own « Anatomy of an oil and gas field » on a field of your choice, researching as necessary to find as much geological and geophysical information as possible. Deliver a Powerpoint presentation, including information about :

- how the field was discovered and drilled
- any important events in the development of the field
- the lithology of the field : source, reservoirs, traps, etc.
- any maps or cross-sections available
- any well logs available, geological or wireline
- the future prospects for the reserve

Your talk will respect the following criteria :

- format : individual presentation or in pairs
- length : minimum 6 mn, maximum 12 mn
- layout : attractive with photos
- pronunciation : keys words checked on [www.howjsay.com](http://www.howjsay.com)
- **no reading** (except occasional look-down at individual notes)
- communication : dynamic to keep your audience's attention focused !



# Azerbaijan's crude oil baths

9 January 2011



**BBC News series focuses on aspects of life in countries and cities around the world. What may seem ordinary and familiar to the people who live there can be surprising to those who do not.**

1/ Where is Azerbaijan located ?

2/ What are they notorious for ? Give two reasons :

3/ What is Naphtalene/ naphtalene (2 answers) ?

4/ What happens as the country's wealth grows ?

5/ Fill in the gaps :

Here in the dry plains of western Azerbaijan, oil has been \_\_\_\_\_ out of the ground for centuries. But in this particular town of Naphtalene they have got so much of the stuff that people have even started to take baths in it. Inside this private \_\_\_\_\_ these Azari men are limbering up for a \_\_\_\_\_ in pure crude oil. Most of them suffer from rheumatoid \_\_\_\_\_. The \_\_\_\_\_ in the local crude oil, naphtalene, is the critical \_\_\_\_\_, local scientists believe it has \_\_\_\_\_ properties. But a crude oil bath is not the only form of \_\_\_\_\_ available.

6/ What are the therapeutic properties of this so-called healing ?

7/ Give other reasons why people would go through such an experience.

8/ Explain the routine of an oil bath.

9/ Tell about the patient's reaction.

10/ Is this treatment given overwhelming support ?





## Brazil's Petrobras Ramps Up Production of Pre-Salt Oil

1/ How would you qualify Brazil's economy from 2005 to 2010 ? Justify.

2/ What prompted such a change ?

3/ What is the problem with the redistribution of oil-generated benefits ?

4/ Translate into French :

*Drilling through the salt crust beneath the seabed proved harder than it anticipated. The oil fields are located in ultra-deep water – nearly 20,000 feet below the surface of the sea. Once they reach that depth, operators must then drill through a layer of salt that can be more than a mile thick.*

5/ List the 3 main issues (= problems) Petrobras has had to face :

①

②

③

6/ How do you understand the sentence : " *Now Petrobras may be turning a corner.*" Explain.

**7/ Tick the right trends (↗= upwards / ↘ downwards) for the following verbs from the article :**

- |               |                            |                            |
|---------------|----------------------------|----------------------------|
| flattened out | <input type="checkbox"/> ↗ | <input type="checkbox"/> ↘ |
| ballooned     | <input type="checkbox"/> ↗ | <input type="checkbox"/> ↘ |
| climb         | <input type="checkbox"/> ↗ | <input type="checkbox"/> ↘ |
| plummeted     | <input type="checkbox"/> ↗ | <input type="checkbox"/> ↘ |
| rebound       | <input type="checkbox"/> ↗ | <input type="checkbox"/> ↘ |
| drop          | <input type="checkbox"/> ↗ | <input type="checkbox"/> ↘ |

**8/ What are the other obstacles that Petrobras must currently surmount ?**

**9/ From your personal knowledge about drilling markets, give a personal opinion on the future for Brazil's oil fields.**

*By Nick Cunningham Oil price | 11 August 2014*

Brazil's economy grew at an astounding pace from 2005 to 2010, thanks to a commodity boom that sent exports of things like soy, beef and iron ore soaring. Brazil had already been a major oil exporter for years, but things really took off after the discovery of a massive deposit of offshore oil in 2007. After that, the country set its sights on becoming one of the top producers in the world.

The discovery of billions of barrels of oil underneath a thick layer of salt presented significant engineering and financing challenges, but a wave of excitement swept through the country. The quasi-state-owned oil company Petrobras issued ambitious production targets -- predicting oil output would hit 5 million barrels per day by 2020, more than double the current rate.

Brazil began to fight over the riches before any oil was even pulled from the pre-salt. The government passed a law in March 2013 that allocated a greater share of revenue to non-oil-producing states. This angered the state government of Rio de Janeiro, because some of the biggest fields are located in its waters.

While the revenue fight played out on land, Petrobras soon ran into trouble offshore. *Drilling through the salt crust beneath the seabed proved harder than it anticipated. The oil fields are located in ultra-deep water – nearly 20,000 feet below the surface of the sea. Once they reach that depth, operators must then drill through a layer of salt that can be more than a mile thick.*

The extreme challenges of getting at the oil have forced Petrobras to invest billions in new equipment and advanced technology, and even still, it has run into delays. From 2010 onwards, Brazil's oil production **flattened out**, after years of increases. As costs **ballooned** and project deadlines slipped, Petrobras racked up enormous debt, so much so that it has been called the world's most indebted major oil company.

Brazil's economy stagnated around the same time, fueling discontent among the general population. Optimism gave way to unease and frustration as the cost of living continued to **climb** and consumer confidence **plummeted**. Petrobras' problems became a symbol of the country's broader woes.

Now Petrobras may be turning a corner. New data shows that production from the pre-salt jumped from essentially nil to 520,000 barrels per day in July. The turnaround is critical for the company, which has seen most of its other wells reach maturity. Many are already beginning to decline.

As the Wall Street Journal noted, Brazil's largest oil field saw its output **drop** from 395,000 barrels per day in 2010 down to its current level of 256,200 barrels per day. Petrobras' annual production slipped in both 2012 and 2013, but it expects to **rebound** this year.

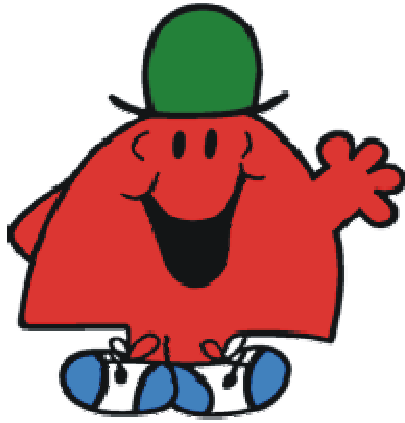
Still, the target of 5 million barrels per day by the end of the decade is probably overly optimistic. Oil analysts project a more modest production level of 4 million barrels per day in that timeframe. But even reaching that level of output would be a notable

achievement for the company, and it would be enough to make Brazil one of the world's five largest oil producers.

Despite the news about rising production from the pre-salt, Petrobras will need to overcome a lot of hurdles to get there. The company has to sell gasoline at below market rates by government decree, in order to fight the effects of inflation. Mandates on the use of local content in drilling projects has raised costs and scared away investors. Petrobras' stock price has dropped by around 75 percent since hitting a high in 2008, and it has declined each of the last five years as debt piled up.

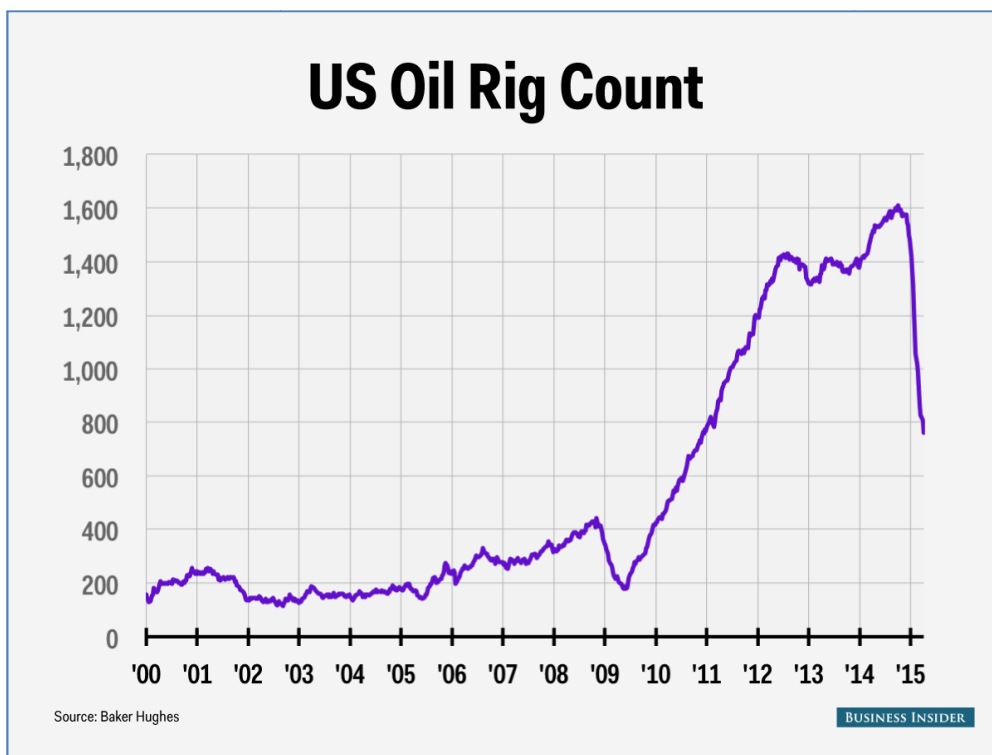
But the biggest problem facing Petrobras is one of engineering. The pre-salt is arguably the most challenging environment to work in for any oil company. Still, there is finally some evidence that Petrobras is making progress.





# Pairwork

Draw the graph that student A describes. Then describe this graph for student A to draw.



# The oil spill file

1/ Fill in the gaps in this definition of an oil spill by someone working on an oil rig :

|          |            |           |             |
|----------|------------|-----------|-------------|
| aground  | collection | drilling  | exploration |
| failure  | mishaps    | refueling | routine     |
| ruptured | storage    | unloading |             |

"What is an oil spill ? Well a lot of oil is spilled during \_\_\_\_\_ operations such as \_\_\_\_\_, loading or \_\_\_\_\_, that sort of thing. Then there are \_\_\_\_\_ and collisions between vessels and \_\_\_\_\_ and other transportation vehicles. Those are the ones that often get in the news. Er... ships running \_\_\_\_\_ is another one. Then we have \_\_\_\_\_ pipelines at sea or on land. And oil \_\_\_\_\_ activities, \_\_\_\_\_ and so on. And of course, there's also mechanical \_\_\_\_\_ of oil \_\_\_\_\_ and \_\_\_\_\_ equipment."

2/ You and your partner have the missing information for one of the ten largest oil spills in US history : answer the group's questions to complete the chart.

| Rank | Date | Cause | Source | Location | Spill volume |
|------|------|-------|--------|----------|--------------|
|      |      |       |        |          |              |
|      |      |       |        |          |              |
|      |      |       |        |          |              |
|      |      |       |        |          |              |
|      |      |       |        |          |              |
|      |      |       |        |          |              |
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|      |      |       |        |          |              |
|      |      |       |        |          |              |
|      |      |       |        |          |              |
|      |      |       |        |          |              |



### 3/ BP Oil spill explained : read this informational text and answer the true/false questions

#### *Five Years Later, What Were the Effects of the BP Oil Spill?*

Five years after a massive oil spill off the coast of Louisiana, the area is still grappling with the consequences. In 2010, the BP oil plant at Deepwater Horizon exploded, killing 11 workers and flooding the seafloor with 134 million gallons of oil. The spill killed thousands of animals, damaged large natural habitats and took a toll on the local economy.

BP has paid more than \$28 billion since the spill in response and cleanup measures along with compensation claims. In January, a judge ruled that BP had been “grossly negligent” in the spill, which could hold the company liable for up to \$13.7 billion in penalties. Today, local businesses that rely on fishing and seafood are still struggling, and many coastal businesses have shut down. In addition, scientists have not determined the long-term impact of the spill on the environment, according to John Young, President of Jefferson Parish in Louisiana. “BP has spent a lot of money and there has been a lot of money in cleanup, but there’s still a lot of unaccounted-for oil that is probably on the seabed of the Gulf,” Young said.

Chemicals from the spill have traveled as far as Rhode Island, making it difficult to determine the far-reaching effects of the spill, according to Mark Schleifstein, environment reporter at The Times Picayune. Litigation related to the incident is also still ongoing, with a number of legal claims pending from people who say the spill cost them business.

#### **Answer these comprehension questions and be ready to justify :**

- a) thanks to the massive cleanup efforts, Louisiana is slowly recovering.  
 true       false       unclear
- b) the consequences were chiefly devastating for the coastline.  
 true       false       unclear
- c) BP has already been heavily fined for negligence.  
 true       false       unclear
- d) the aftermath is of unprecedented scale and complexity compared to previous disasters.  
 true       false       unclear
- e) although BP appealed the court's decision, they may have to settle other compensations.  
 true       false       unclear

#### **Critical thinking : do some research on the web and answer these questions for next class as a Moodle discussion**

1/ *Keith Feinberg, who administered an independent claims fund, described an instance of a restaurant in Boston that could no longer serve a favorite seafood dish. In this case, would BP be responsible for compensating them? How should courts decide when to hold BP accountable?*

2/ *What can governments do to prevent similar incidents from happening in the future?*

#### 4/ How to kill an oil spill : new methods

Study these documents and write a summary explaining the dos and don'ts of each method.

##### **Slik operation: new device to remove oil from troubled waters**

Euronews, 06th April 2015

Marine oil spills can be extremely difficult to deal with, requiring a lot of time and effort by experts to remove the pollutant from the surface of the water.

In the sea of Cardiff, Wales engineers from a European research project are testing a new prototype that cleans oil spills quickly, efficiently and more cheaply than existing methods, which require multiple vessels and complex oil containment measures. "What we've developed is a net which can float on the surface of the water, without using any containment booms," explained James Ilesley, an environmental engineer and managing director of OPEC Ltd, which is developing the system. .

The simplicity of the technology is an important aspect, according to Federico Meneghello, FORCE7 project coordinator: "A big advantage is that this system can operate with a single boat, and can work in stormy seas, because it doesn't need to coordinate with other ships." The point is reinforced by Ilesley: "Using this system, we can operate in very heavy seas, such as force seven conditions, where the wave heights would be quite high, and the polypropylene net would follow these wave contours to be able to collect oil from the slicks," he said.

The 'mop' soaks up engine oil from the surface without collecting an excess of water. Its synthetic fabric is made of hydrophobic fibres and has a multi-layer structure, which is good for different types of oil products. State-of-the-art textiles are a key element. "You never know what kind of oil spills will happen – you never know if it'll be heavy oil or light oil, so you have something like a compromise between two of these things, so you can collect heavy oil and you can collect light oil, and also you have a very strong structure," said Monika Rymarczyk, a researcher in functional thermoplastic textiles, working on the project.

There are existing mops and absorbent mats but they are less efficient at soaking up oil and tend to sink, according to Federico Meneghello: "This material which is being used nowadays; when it's submerged, its surface gets soaked with water, so it sinks. Whereas the material developed within the project repels water and holds oil while staying afloat."

The next step for the engineers is to turn the research prototype into a commercial product that will have a much larger surface. The mops are capable of absorbing up to 50 times their weight in oil, which can be removed on board the ship with a special machine. Then the mops can be immediately reused, said Ilesley: "The mops are recovered, carrying all the oil that is squeezed off through the yellow rolls that you see there, drops into the bottom, is then pumped onboard to storage tanks. Water can be separated and pumped back to sea if it's clean enough, or taken away for further processing."

Engineers expect the design to be finalised in the coming months, and the new product should hit the market in less than a year.



## On the fifth anniversary of giant Gulf oil spill, a look at new remediation technology.

Inside Science, Apr 20 2015

***The Deepwater Horizon oil rig exploded in the Gulf of Mexico five years ago today, killing 11 people. The leak that followed spilled millions of barrels of oil, creating one of the worst environmental disasters ever. Despite renewed safety efforts, disastrous accidents will almost surely happen again.***

During the Deepwater Horizon disaster, cleanup workers used a number of methods to reduce the spill's impact, including boats that skim the oil off the gulf's surface, chemicals that disperse the oil, oil-absorbing pom-poms, and even burning. Now, researchers have developed a new potential tool: a high-tech coated mesh that separates oil from water with the ease of a sieve.

"There's only so much oil you can absorb," said materials scientist Bharat Bhushan of The Ohio State University. "What we try to do is rather than absorb it, we try to separate the two." To make an oil-separating sieve, Bhushan and Philip Brown, a materials scientist also of Ohio State, took a stainless steel mesh and made it bumpy by coating it with nanoparticles sandwiched between two layers of polymers. Then, they covered the mesh with a fluorosurfactant, a type of chemical that attracts water but repels oil.

Those nanoparticle bumps are crucial because they increase the surface area of the mesh, which in turn enhances the outer layer's oil-repelling properties. It's a trick the researchers borrowed from the lotus leaf, whose waxy and bumpy surface repels water. In the end, they get a mesh that's really good at letting water flow through — but not oil. The research was published in the journal *Scientific Reports*.

You could then make the mesh into a big net to ensnare spilled oil. Or, Brown envisions using the mesh as a filter. Clean up crews could pump the contaminated water through it. The materials in the coating are environmentally friendly and cheap, Bhushan said, potentially costing as little as a dollar per square foot. And unlike other oil-repelling coatings that break down quickly, initial tests show that this one's durable, which would enable a coated mesh to be reused over and over again.

"It's another kind of nanotechnology for dealing with oil-water contamination —that's what makes it exciting," said Perena Gouma a materials scientist at the State University of New York at Stony Brook. She's glad to see new approaches for cleaning oil spills using nanotechnology.

But one thing to determine is how well the mesh can clean water. "The eye may not see the oil, but is the oil still there?" she asked. Benzene or other oil products can still lurk inside what looks like clean water. For her part, Gouma is commercializing her own oil-cleaning mesh, a nanoscale grid of copper tungsten oxide that you place on the contaminated water. But instead of separating the oil, the grid breaks it down when exposed to sunlight.

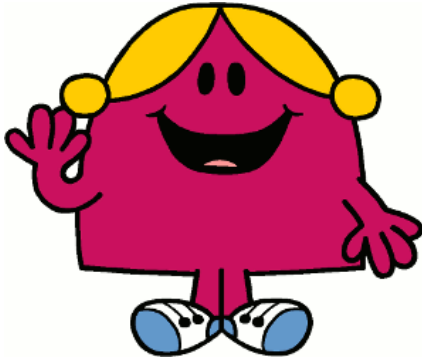
It will still be a few years before Bhushan's oil-separating mesh is ready for real-world use, and engineers will have to figure out how best to deploy it. For one, they will have to design a coated mesh that's strong enough to survive the open ocean, said Ed Levine of the National Oceanic and Atmospheric Association, who works with the Coast Guard to clean up oil spills, including the Deepwater Horizon spill. At least in the beginning, a net might be best suited for calmer, more controlled settings like in a lake.

If the mesh is used as a filter in a pump, however, the advantages aren't quite clear. A boat equipped with such a pump might not be much better than current methods that vacuum or skim the water for oil, Levine said. In the meantime, the Ohio State researchers are also developing their technology for uses other than oil cleanup. The coating could make surfaces resistant to oily dirt or finger smudges. The nanoparticles are made from silica, one of the ingredients of glass, which allows the coating to be 70 percent transparent—not quite good enough for smudge-free screens, but maybe sufficient for smudge-free mirrors. And if you swap out the top, oil-repelling layer with a water-repelling one, you could make mirrors that don't fog up or get icy.

But if the mesh is used for oil spills, it will always be one of many techniques.

"There's no one silver bullet," Levine said. "It's not like we have one oil spill and we say, bring out the mesh, and we don't need anything else." That's because oil spills—especially in the ocean — happen in all kinds of weather, water, and temperature conditions. Then there's the oil. "Oils come in very different viscosities, from thin as water to thick as peanut butter," he said. Every situation requires different tools; innovations are always welcome.





# Pairwork

## Student A

*Read this incident report . Student B has got the missing information. Ask him/her questions to find out.*

\_\_\_\_\_ a fire occurred in the crude unit at \_\_\_\_\_ in Martinez, California. Workers were attempting to replace \_\_\_\_\_ attached to a \_\_\_\_\_-tall fractionator tower while the process unit was in operation. During \_\_\_\_\_, naphtha was released onto the hot fractionator and ignited. The flames engulfed \_\_\_\_\_ workers located at different heights on the tower. Four men were \_\_\_\_\_ and one sustained serious injuries.

## Student A

*Read this incident report . Student B will ask you some questions. Be ready to answer his/her questions.*

BP plc said a crude distillation unit (CDU) caught fire on 4 October at the Lingen refinery in West Germany. One person was hospitalised. "The fire was brought under control in about 30 minutes and damage was contained to that unit, a BP spokesman in London said. "The CDU that caught fire has been shut down but the refinery has a second CDU that remains operational", BP said. The fire broke out while the unit was coming back after summer maintenance.



**KEEP  
CALM  
AND  
CALL THE  
MINER**

# Mining

**A/ Match the word and its English definition ; you may then find a suitable translation in your language.**

|               |   |
|---------------|---|
| 1. clay       | A. sedimentary rock consisting of at least 50% calcium carbonate (CaCO <sub>2</sub> ) by weight.  |
| 2. coal shale | B. rich accumulation of minerals in solid rock. Frequently in the form of a layer or an area with a large concentration of disseminated particles.  |
| 3. gemstones  | C. clastic sedimentary rock that is made up of clay-size (less than 1/256 millimeter in diameter) weathering debris. It typically breaks into thin flat pieces  |
| 4. gravel     | D. Clastic sedimentary particles of any composition that are over 2 mm in diameter.   |
| 5. limestone  | E. a vein of ore, esp one of gold-bearing quartz  |
| 6. lode       | F. a stratum of coal, ore, etc  |
| 7. orebody    | G. A natural accumulation of a metal, gemstone or other valuable mineral substance, which is rich enough in concentration that it can be mined and processed at a profit.   |
| 8. potash     | H. A fracture that has been filled with mineral material.   |
| 9. reef       | I. a form of potassium that is used especially to improve soil  |
| 10. rock salt | J. A clastic mineral particle of any composition that has a grain size smaller than 1/256 mm. The term is also used in reference to a broad category of hydrous silicate minerals in which the silica tetrahedrons are arranged into sheets.  |
| 11. seam      | K. A chemical sedimentary rock that forms from the evaporation of ocean or saline lake waters. It is also known by the mineral name "halite". It is rarely found at Earth's surface, except in areas of very arid climate. It is often mined for use in the chemical industry or for use as a winter highway treatment. |
| 12. vein      | L. precious or semiprecious stone, esp one cut and polished for setting in jewellery  |

|   |   |   |   |   |   |   |   |   |    |    |    |
|---|---|---|---|---|---|---|---|---|----|----|----|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|   |   |   |   |   |   |   |   |   |    |    |    |



## B/ Aussie mineral resources quiz

1. Australia has the world's largest deposits of which mineral?

- a) Iron ore
- b) Uranium
- c) Gold
- d) Bauxite



2. Which metal is the least likely to occur in its pure form in nature?

- a) Gold
- b) Copper
- c) Silver
- d) Aluminium

3. What was the first metal mined in Australia?

- a) Iron ore
- b) Tin
- c) Gold
- d) Lead

4. Lead is commonly extracted with what other metal:

- a) Tin
- b) Silver
- c) Iron
- d) Uranium

5. Coking coal is used to make steel. What kind of coal is it?

- a) Brown coal
- b) Sub-bituminous coal
- c) Bituminous coal
- d) Anthracite

6. Hematite is a source of:

- a) Iron
- b) Zinc
- c) Copper
- d) Nickel

7. Australia's largest gold deposit is located in which state:

- a) Western Australia
- b) South Australia
- c) Victoria
- d) Queensland



8. Kimberlite is a type of igneous rock. What is found in kimberlite?

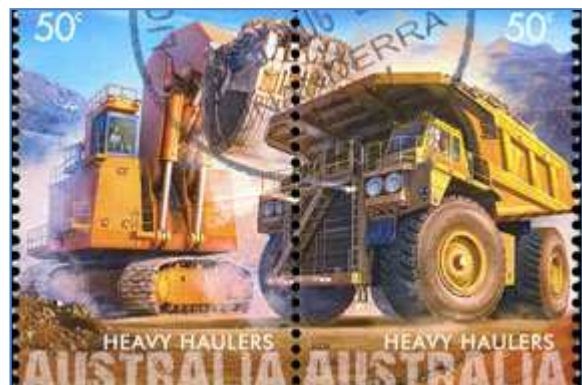
- a) Iron ore
- b) Gold
- c) Diamonds
- d) Uranium

9. Nickel is combined with iron to make:

- a) Stainless steel
- b) Galvanised steel
- c) Mild steel
- d) Tool steel

10. Which everyday product DIDN'T start out as a grain of mineral sand?

- a) TV screen
- b) Food colouring 171
- c) Ball point pen
- d) Pewter vase



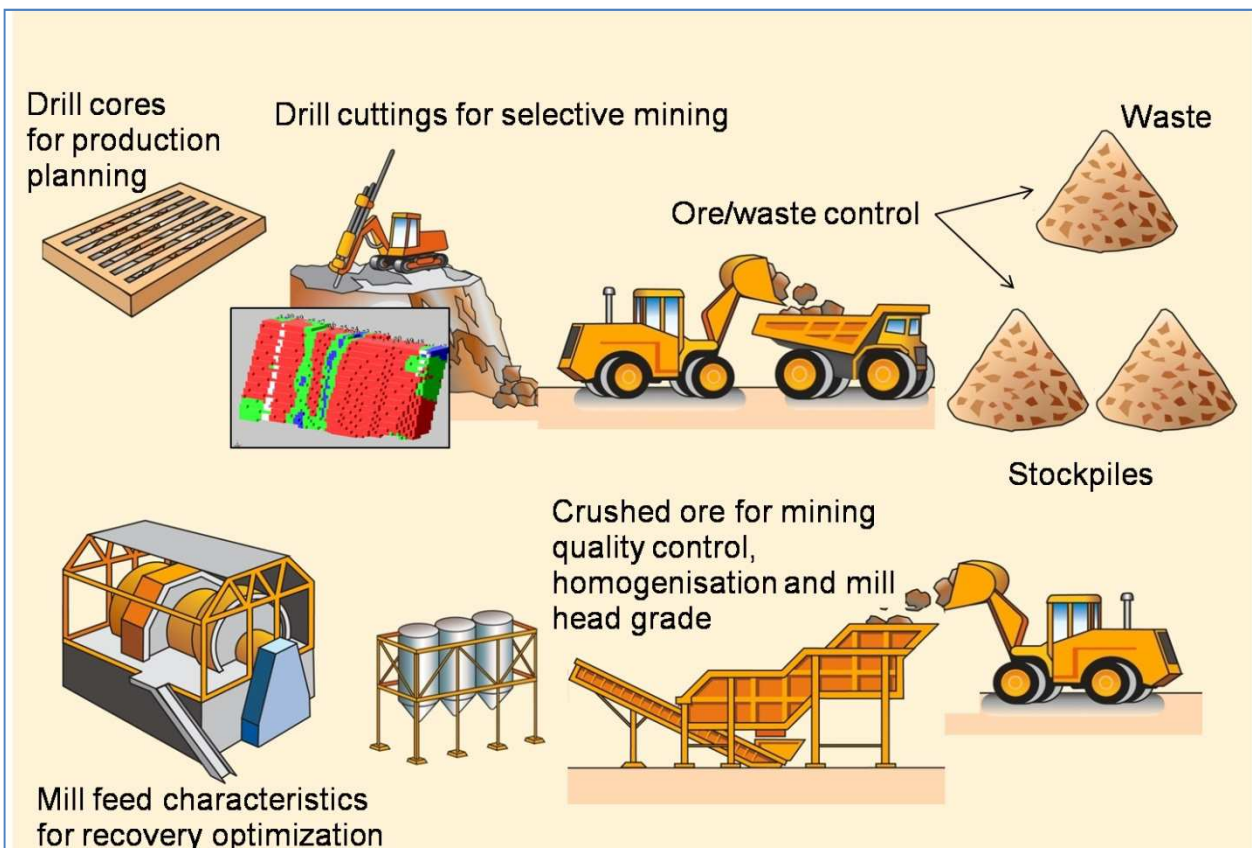
### C/ Mining : definition

|              |            |              |              |
|--------------|------------|--------------|--------------|
| agricultural | analysis   | artificially | closed       |
| economic     | extraction | extraction   | gemstones    |
| laboratory   | materials  | metals       | minerals     |
| orebody      | petroleum  | potential    | pre-historic |
| reclamation  | seam       |              |              |

**Mining** is the 1\_\_\_\_\_ of valuable 2\_\_\_\_\_ or other geological 3\_\_\_\_\_ from the earth from an 4\_\_\_\_\_, lode, vein, 5\_\_\_\_\_, or reef, which forms the mineralized package of 6\_\_\_\_\_ interest to the miner.

Ores recovered by mining include 7\_\_\_\_\_, coal and oil shale, 8\_\_\_\_\_, limestone, and dimension stone, rock salt and potash, gravel, and clay. Mining is required to obtain any material that cannot be grown through 9\_\_\_\_\_ processes, or created 10\_\_\_\_\_ in a 11\_\_\_\_\_ or factory. Mining in a wider sense includes 12\_\_\_\_\_ of any non-renewable resource such as 13\_\_\_\_\_, natural gas, or even water.

Mining of stone and metal has been done since 14\_\_\_\_\_ times. Modern mining processes involve prospecting for ore bodies, 15\_\_\_\_\_ of the profit 16\_\_\_\_\_ of a proposed mine, extraction of the desired materials, and final 17\_\_\_\_\_ of the land after the mine is 18\_\_\_\_\_.





**D/ Mine development and lifecycle ; reorder the processes in the chronological order :**

- A. Beginning of development to create access to the ore body : the mine buildings and processing plants are built and any necessary equipment is obtained.
- B. Conducting a feasibility study to evaluate the financial viability, technical and financial risks and robustness of the project.
- C. Conducting a pre-feasibility study to determine the theoretical economics of the ore deposit.
- D. Decision by mining company to develop the mine or to walk away from the project.
- E. Defining the extent, location and value of the ore body
- F. Detailed characterization of the waste material
- G. Discovery of the ore body, which is carried out through prospecting or exploration
- H. Mathematical resource estimation to estimate the size and grade of the deposit
- I. Mining through or removing waste material which is not of immediate interest to the miner.
- J. Reclamation to make the land used by the mine suitable for future use
- K. Recovery of all the ore that the mine can produce profitably

| Step 1 | Step 2 | Step 3 | Step 4 | Step 5 | Step 6 | Step 7 | Step 8 | Step 9 | Step 10 | Step 11 |
|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|
|        |        |        |        |        |        |        |        |        |         |         |



# URANIUM MINERALS (ABC, Catalyst, 11th June 2009)

1/ Which solution should we find about nuclear energy to prevent environment destruction ?

2/ Where is the quarry located ?

3/ List the minerals mentioned in the video.

4/ Did the discovery of uranium benefit the local community ? Justify.

5/ Give the mine's historical landmarks.

6/ What does geochemist Dr Maas' job involve ?

7/ Fill in the gaps :

The new uranium \_\_\_\_\_ are stable and \_\_\_\_\_ – they lock up uranium for millions of years. And Uranium \_\_\_\_\_ contain up to fifty \_\_\_\_\_ percent of uranium so they are an ideal place to lock up uranium.

*It's early days in this research into how these \_\_\_\_\_ crystals of such unusual minerals formed in the first place. But the promise is there of \_\_\_\_\_ a safe way to store uranium over geological \_\_\_\_\_.*

Like it or not nuclear power is here to stay and as long as we've got a nuclear industry we're going to need to be able to clean up uranium \_\_\_\_\_ coming out of the \_\_\_\_\_ and at the mine sites. Maybe these magic \_\_\_\_\_ from western \_\_\_\_\_ will show us a new way to clean up after ourselves.

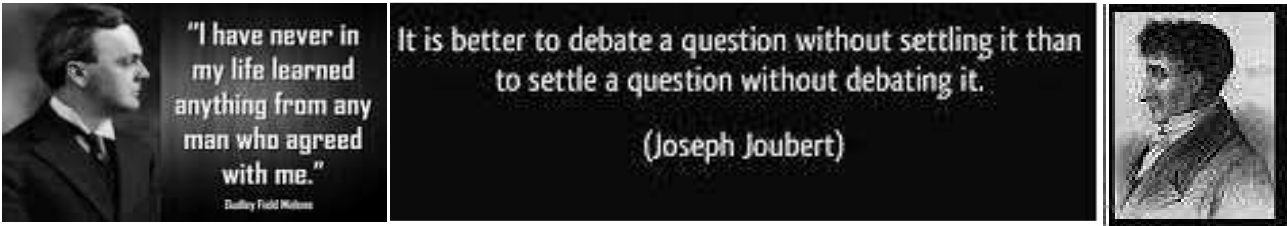


# DEBATING





## What else?!



### Skills required for a successful debate:

- Expressing and presenting an opinion
- Building arguments logically
- Listening to your challenger's rebuttal
- Countering his/her arguments taking into account what seems acceptable in his/her position



Remember that the ultimate goal of each debate is to find a compromise after reaching a “middle of the road” position.

This will also help you develop skills in the areas of interpersonal influence, teambuilding, group problem solving.



## I. Preparatory activities:



Choose the right item :

- 1/ I'm  in  of  about the opinion that the government is fundamentally wrong...
- 2/ I  like  would  can to think that I'm more handsome than Tom...
- 3/ I  have  Ø  am convinced that this is the best option...
- 4/ I must  stress  focus  imagine that there are more important things to talk about...
- 5/ Just to reiterate: I must say I am  opposite  contrary  against marriage between cats and dogs...
- 6/  Who  Where  Which do you stand on abortion?
- 7/ Can we address the issue  at  of  on abortion?
- 8/ I  have agree  am agree  agree with what you're saying...
- 9/ You've got  a point  reason  right ...
- 10/ I  look  observe  see your point ...
- 11/ I'm all  with  for  in lower taxes...
- 12/ I  have  am  Ø pro women's rights...
- 13/ I'm afraid I  have to  to be  am disagree...
- 14/ I am not persuaded this is  the better  the good  the best option...
- 15/ As  much  more  better as I'd like to agree with you, I can't; it's against my morals, it's against everything I believe...
- 16/ I can't agree  for  of  with that...
- 17/ I have to take  exit  leave  issue with that because I'm a democrat ...
- 18/ I  have  am  be against fox hunting...
- 19/ I'm  anti  con  reverse war...
- 20/ Is it not therefore more  benefit  profit  beneficial to do it this way?
- 21/ The point that you make is  interest  interested  interesting but is negated by the fact that your opinion is biased...
- 22/ Doesn't it make more  meaning  sense  logic to start the day at 12? Who's with me?
- 23/ Have you  considered  observed  watched the risks?

**IT'S OK IF YOU  
DISAGREE WITH ME.  
I CAN'T FORCE YOU TO BE RIGHT.**

# AGREEING & DISAGREEING

## Bank of expressions

### Asking for an Opinion

What's your opinion of...?  
What's your position on...?  
I'd like to hear your views on....

### Introducing

To begin with, as an introduction, first and foremost

### Reformulating

What did you mean when you said that....?  
You made a good point when you said that....

### Summarizing

To summarize, I think we are in agreement on...  
Briefly, the main points that have been made are...  
In short,.....

### Giving An Opinion

- *Strong Agreement:* I completely agree.  
I'm in total agreement.  
It's my belief/quite clear that....
- *Neutral Agreement:* I agree.  
I think you're right.  
In my opinion...
- *Partial Agreement:* I would tend to agree with you on that.  
It seems to me that...  
By and large I would accept your views, but...
- *Softening Strong Disagreement:* To be quite frank,...  
With respect,...  
I don't share your point of view.
- *Strong Disagreement:* I totally disagree with you.  
Under no circumstances could I agree to that.
- *Softening Neutral Disagreement:* I'm afraid...  
I respect your opinion, of course, however...
- *Neutral Disagreement:* We'll have to agree to differ.  
I feel I must disagree.  
I really must take issue with you here.
- *Tactful Disagreement:* You have a point there, but...  
I can see your point of view, but surely...

### Asking for a Reaction

Could I ask for your reaction to....?  
Where do you stand on this issue?

### **Bringing in to Answer a Question**

I wonder if you'd like to comment, Ms. Lang?

I'd like to ask my colleague to give her views on that.

I think Mr. Doe is more qualified than I am to deal with this question.

### **Bringing in to Present a Point**

Allow me to give the floor to Ms. Smith.  
Mr. Jones, would you care to comment?

### **Debating Link Words and Phrases**

o *Adding information:*

besides, on top of that, furthermore,  
what's more, in addition to, not to mention, also

o *Contrasting:*

but, yet, still, nevertheless, although, whereas,  
despite, on the contrary, on the other hand,

o *Justifying:*

that's why, for example, because of, for  
instance

### **Compromising**

o *Offering a Compromise:*

We are prepared to ....on condition that...  
I believe we can...if...

o *Asking if it's Acceptable:*

Is that acceptable as a compromise solution?  
We hope that this will be acceptable.

o *Adding a Condition Positively:*

Our agreement is conditional on...  
If you would be prepared to..., then we could...

o *Adding a Condition Negatively:*

I don't think we could....unless....  
We have certain reservations about...and  
unless...

o *Accepting a Compromise:*

We see no objection to that.  
I think that would be perfectly acceptable.

o *Rejecting a Compromise:*

You leave us with little alternative but to...  
You put us in a difficult position.

### **Playing for time**

That's a very interesting question.

That's a difficult question to answer. I'm glad  
you asked that question.

You have raised an important point there.

I'm sure you will appreciate how complicated  
this matter is.



# Debating topics at a glance

## Topic 1 : Should fracking be banned ?

Shale gas is a term used to describe natural gas trapped as hydrocarbons within saturated rock formations, especially the sedimentary rock shale. Although quite widespread, until the past decade or so shale gas has not been much exploited as an energy source as it cannot be extracted easily and cheaply by traditional drilling techniques. In recent years this has changed as higher energy prices have made investment in shale gas fields more worthwhile, and improved extraction techniques have meant that unconventional sources of energy can now be exploited more easily. The main process involved in extracting shale gas is hydraulic fracturing ("fracking"), where a fluid is forced down a well to create a build-up of pressure in the rock below, forcing it to break up and allowing the gas contained within it to be recovered to the surface.

Shale gas formations can be found across much of the Eastern and Central parts of North America. Exploitation first took off in 2000; the number of wells in the Barnett shales of Texas grew from less than 600 to over 9000 in the eight years to 2008. Other deposits being exploited include the Marcellus shales of New York and adjacent states, and the Haynesville shales in Louisiana and Texas. There is now interest in exploiting similar deposits across the border in Quebec, as well as in Poland and the UK within Europe.

## Topic 2 : Should biofuels be subsidized ?

Biofuels are sources of energy which come from living, renewable sources, such as crops, trees and even animal manure. Fossil fuels like oil, gas and coal, on the other hand, formed in the earth from decaying vegetation many millions of years ago, and cannot be renewed. In recent years biofuels have come to mean fuels such as ethanol and biodiesel which can be burned in engines to drive vehicles in place of fossil fuels like petroleum and diesel.

Ethanol can be made from a variety of crops, such as maize or sugarcane, while biodiesel is often made from palm oil, soya or rapeseed (canola). In the past biofuels have not been given much attention (save in Brazil, which has little oil but much sugar cane to convert into transport fuel), but this is rapidly changing. As the price of oil has soared in the past few years and biofuel production methods have improved, the price gap has narrowed considerably although levels of subsidy are an important part of the economic equation. Biofuels have also been promoted as a way of reducing carbon emissions and so of tackling global climate change.

## Topic 3 : Should offshore drilling be encouraged ?

Offshore drilling is an extremely contentious topic in the American discourse. Due to concerns over the environmental impact of offshore oil extraction, a moratorium on offshore drilling was passed in 1981 and Congress has renewed it every year since. However, in 2010 President Obama lifted the moratorium on offshore drilling. Rising gas (petroleum) prices and increasing political pressure, especially from Republicans in oil-rich states such as Alaska's Sarah Palin, have generated intense debate about lifting the moratorium.

In April 2010 caused a massive oil leak from a deep-water oil rig in the Gulf of Mexico operated by BP. The leak poured out oil for four months, becoming the worst such disaster in US history, and inflicting massive environmental damage and economic harm upon Gulf states such as Louisiana and Alabama. One natural consequence was renewed concern about the wisdom of more offshore drilling and calls for much tighter regulation of existing oil wells.





## USEFUL WORDS AND PHRASES

|  |   |
|--|---|
| a growing environmental threat :                                       | une menace croissante sur l'environnement             |
| a risky bet  | un pari risqué  |
| a tax break  | un cadeau fiscal                                      |
| a volatile market  | un marché volatile                                    |
| a yield  | un rendement  |
| an incentive   | une prime d'encouragement                             |
| clean-up costs   | les coûts de remise en état                           |
| commodities  | les marchandises                                      |
| cost-effective measures  | des mesures rentables                                 |
| drilling companies   | les compagnies de forage                              |
| energy consumption   | la consommation d'énergie                             |
| government support   | le soutien (financier) du gouvernement                |
| household budget   | le budget des ménages                                 |
| landowners   | les propriétaires terriens                            |
| lease payment  | le paiement des loyers                                |
| nearby residents   | les riverains   |
| proponents of .../ opponents, sceptics of...                           | les supporters / les opposants                        |
| renewable energy sources (such as solar, <u>tidal</u> and wind energy) | l'énergie marémotrice                                 |
| taxpayers  | les contribuables                                     |
| the extraction process   | le processus d'extraction                             |
| the law of supply and demand   | la loi de l'offre et de la demande                    |
| the precautionary principle  | le principe de précaution                             |
| the release of gas   | l'émission de gaz                                     |
| this is not the only answer, but one in basket of solutions            |   |
| to be hand-tied  | avoir les mains liées, ne pas pouvoir agir            |
| to be in denial over something   | être dans le déni par rapport à ...                   |
| to have devastating impacts on...                                      | avoir des effets dramatiques sur...                   |
| to jeopardize  | mettre en danger                                      |
| to live up to its promises   | tenir ses promesses                                   |
| to lose leverage over....  | perdre son influence sur...                           |
| to make a living from...   | vivre de...   |
| to make fuel from crops  | fabriquer du carburant à partir des récoltes          |
| to meet clean air standards  | répondre aux régulations d'air pur                    |
| to move towards a lower-carbon future                                  | évoluer vers des émissions de carbone moindres        |
| to pay off   | être rentable   |
| to phase out   | éliminer progressivement (intransitif)                |
| to postpone the necessary shift to a low-carbon economy                | : retarder le passage nécessaire à une économie verte |
| to provide evidence about...   | fournir des preuves                                   |
| to raise serious safety concerns over...                               | soulever des soucis de santé publique                 |
| to run out of  | être à court de, ne plus avoir...                     |
| to seek energy alternatives  | chercher des alternatives énergétiques                |
| to tackle global climate change  | s'attaquer au problème du réchauffement climatique    |
| to use up fossil fuel resources  | épuiser les ressources d'énergie fossile              |
| worthwhile approaches  | des approches payantes, salutaires                    |

## Academic Writing

- ✓ Academic writing is clear, concise and based on research – to increase knowledge
- ✓ Uses deductive reasoning, third person voice, and is more formal than some other types of writing



# Writing and understanding an abstract

An abstract is a shortened version of the paper and should contain all information necessary for the reader to determine:

- (1) what the objectives of the study were;
- (2) how the study was done;
- (3) what results were obtained;
- (4) and the significance of the results.

Frequently, readers of a scientific journal will only read the abstract, choosing to read at length those papers that are most interesting to them. For this reason, and because abstracts are frequently made available to scientists by various computer abstracting services, this section should be written carefully and succinctly to have the greatest impact in as few words as possible.

**1/ A number of different reporting verbs can be used in author-prominent citations. Complete the definitions using the reporting verbs below:**

|          |             |          |             |
|----------|-------------|----------|-------------|
| conclude | demonstrate | discover | hypothesise |
| observe  | prove       | suggest  |             |

- (1) \_\_\_\_\_ or (2) \_\_\_\_\_: to use an experiment to show that something is true
- (3) \_\_\_\_\_: to carefully watch the way something happens, then record it.
- (4) \_\_\_\_\_ and (5) \_\_\_\_\_: to give a possible explanation for something which has not \_\_\_\_\_ been proved.
- (6) \_\_\_\_\_: to decide something after thinking about it carefully
- (7) \_\_\_\_\_, to find or learn information, especially something new.

**2/ The text of an abstract must be concise. Replace the underlined words in extracts 1-5 below with that or those:**

1/ The hormone increased the power output of healthy volunteers by 16 per cent after four weeks of taking the drug. Healthy volunteers who took the drug could also exercise 50 per cent longer than control subjects.

2/ We compare photographic exposure from scattered light with light from direct light.

3/ The target yield is the yield which can be produced in « perfect » conditions.

4/ Structures like the structures described in this paper are not known in glyptodonts recorded before the Great American Biotic Interchange (GABI).

5/ The lithology of failed carbonate strata differs from the lithology of their basal shear surfaces.

**3/ The following phrases can also be used to signal the purpose of each part of an abstract. Divide the phrases (a-l) into four groups according to functions (1-4):**

**Functions**

- 1/ state the research question
- 2/ present the hypothesis
- 3/ introduce the method
- 4/ introduce key results

**Phrases**

- a/ an investigation was undertaken to explore...
- b/ it seems likely that...
- c/ results show that ...
- d/ the aim of the study was to ....
- e/ the data suggest that ...
- f/ the present study investigates...
- g/ the study provides strong evidence that ...
- h/ we demonstrate that...
- i/ we expected that ...
- j/ we investigated a new method of VERB-ING
- k/ the method involved VERB-ING
- l/ was found to...

| Function 1 | Function 2 | Function 3 | Function 4 |
|------------|------------|------------|------------|
|            |            |            |            |

**4/ Reading an abstract and tackling the main comprehension hindrances**

▶ **Tenses**

List the tenses used and their verb forms in Abstract n°1. Which ones stand for<sup>1</sup>

- temporary actions :
- habitual actions :
- an important result in the present situation :
- on-going situations (not yet completed) :
- memories :
- finished actions :
- from then till now :
- past duration :
- temporary past :
- first of two past events :

---

<sup>1</sup> only a few points are to be used, not ALL of them

►► **Compound nouns and adjectives**

*Shallow groundwater / Domestic water wells* are examples of basic compound nouns and adjectives ; these are groups of words or adjectives combined to express a complex single idea. They are widely used in scientific English since they allow concepts with multiple meanings to be expressed in a concise way. Find in Abstract n°1

☐ several large compounds and translate them :

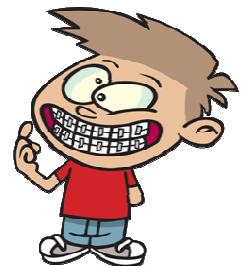
☐ some compound adjectives including verbs :

►► **Irregular plurals**

Can you find the two irregular plurals in Abstract n°1 ?

- singular : ..... plural :
- singular : ..... plural :

Do you know of any other ones that are recurring in scientific English ?



► **Link words and adverbs**

List the above-cited items in Abstract n°2 ; which equivalents could you replace them with ?

link words

adverbs





ELSEVIER

**Abstract n° 1**

**Pre-drilling water-quality data of groundwater prior to shale gas drilling in the Appalachian Basin: Analysis of the Chesapeake Energy Corporation dataset**

Published in *Applied Geochemistry*, Volume 63, October 2015, Pages 37–57

Unconventional natural gas production in the Marcellus and Utica formations of the Northeastern United States raises concerns about potential impacts to shallow groundwater. We examined and interpreted 13,040 analyses from pre-drilling groundwater samples from domestic water wells in northeastern (NE) Pennsylvania and 8004 samples from water wells in the “Western Area” which includes southwest Pennsylvania, eastern Ohio, and north-central West Virginia. These samples were acquired on behalf of Chesapeake Energy Corporation as part of its local pre-drilling water supply monitoring program. We evaluated concentrations of major ions and metals relative to federal drinking-water-quality standards upon which regulatory decisions are often based. Chesapeake’s dataset, the most comprehensive for these areas, shows that exceedance of at least one water-quality standard occurs in 63% of water well samples in NE Pennsylvania and 87% in the Western Area. In NE Pennsylvania, 10% of the samples exceeded one or more of the United States Environmental Protection Agency’s (USEPA) primary maximum contaminant levels (MCLs) for drinking-water supplies, 46.1% of the samples exceeded one or more of USEPA secondary maximum contaminant levels (SMCLs), and another 7% exceeded one or more of USEPA health advisory or regional screening levels for tap water.

In the Western Area 8% of samples exceeded one or more MCLs, 65% exceeded one or more SMCLs, and 15% exceeded one or more health advisory or regional screening levels for tap water. Chesapeake’s dataset, orders of magnitude larger than any in previously published literature, shows that water-quality exceedances relate to factors such: as where the sample occurs within the groundwater flow system, the natural groundwater chemical type (hydrochemical facies), the geologic unit producing the water, and/or the topographic position (valley versus upland). Our comparison of these results to historical groundwater data from NE Pennsylvania, which pre-dates most unconventional shale gas development, shows that the recent pre-drilling geochemical data is similar to historical data. We see no broad changes in variability of chemical quality in this large dataset to suggest any unusual salinization caused by possible release of produced waters from oil and gas operations, even after thousands of gas wells have been drilled among tens of thousands of domestic wells within the two areas studied.

Our evaluation also agrees with early researchers such as Piper (1933) and Lohman (1939, 1937) who found that the saline waters in both areas underlie fresher groundwater. The saline water is naturally-occurring connate brine or salt water which has not been flushed by circulating meteoric water; rather than vertical migration of salt water from deep strata such as the Marcellus shale as suggested by Warner et al. (2012). Elevated metal concentrations, particularly iron and manganese, partly relate to sample turbidity; dissolved metals would provide a more accurate measurement of metals in shallow groundwater than does the total metal analysis typically required by regulations.

## **Technical Paper: The Challenge of the Obayied Field: Novel PDC Design Sets New Performance Benchmarks in Egypt's Difficult Deep Western Desert Lithology Column**

**Presentation Date:** 2015

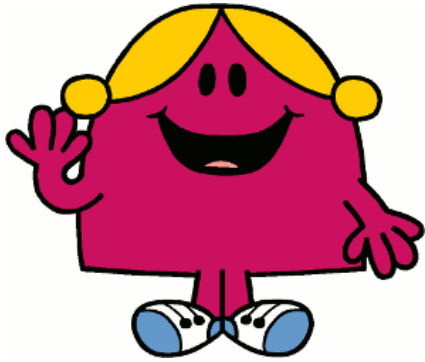
Drilling the deep lithology column using PDC bits in the Obayied field of Egypt's Western Desert has been extremely difficult. The field's lithology column represents an amplification of all of the typical lithology characteristics in the Western Desert. The highly interbedded sandstone, siltstone, and shale—along with the variance of such interbedding across the field—has been a significant challenge for well planners and has adversely affected cost per foot. The application is characterized as predominantly abrasive and impact-intensive in the same section, hence challenging for PDC bit durability. To efficiently drill the 8½-in interval, a fundamental change in PDC bit design is required.

Considering these formidable challenges, service providers had to evolve PDC bits to meet the constant demand of improving performance and reducing costs. Focus was concentrated on balancing new technology developments and the willingness to invest on field trials. To accomplish these objectives in the Obayied field, the operator and the service provider identified two main problems—developing an in-depth understanding of rock strength characteristics of each individual formation in the deep rock column and its variance across the field, and developing PDC bits that can survive such a challenging rock column with improved durability and ROP.

Recently, a novel conical diamond element (CDE) with extreme impact- and abrasion-resistant characteristics has been developed. The CDE has been incorporated at bit center in a new and innovative PDC design, solving the traditional challenge of the inefficient characteristic of PDC bit central area. In addition, a field-wide rock strength study based on sonic and gamma rays logs provided the transparency required for better planning and risk management to resolve the operational inefficiencies traditionally seen in the Obayied field.

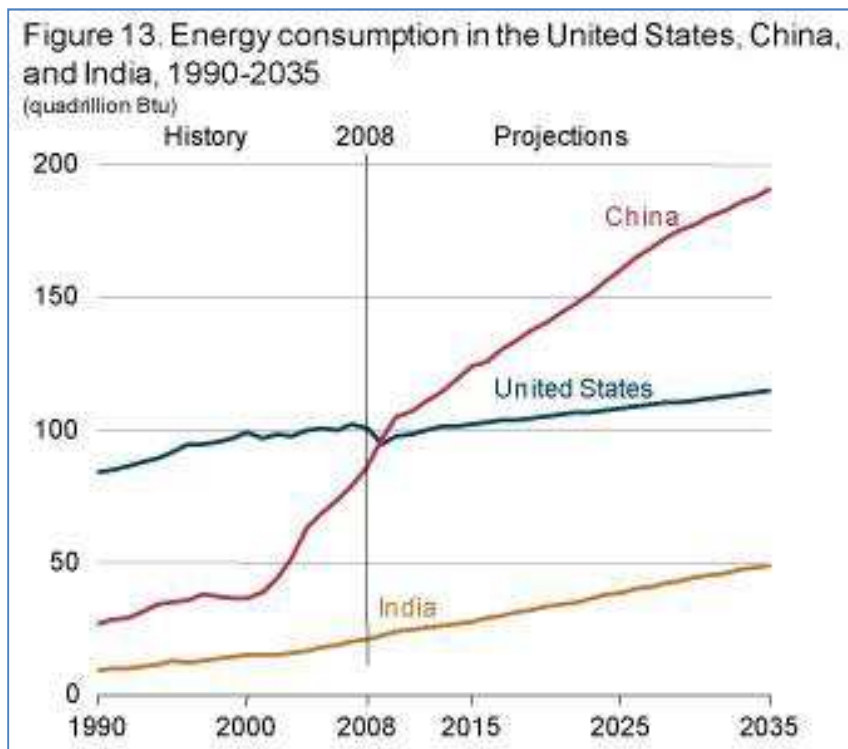
The new PDC bits utilizing the CDE technology has been deployed in Obayied and has reduced consumption to just 3–4 bits per section in 2014, whereas that number was 8–10 bits per section averaged in 2006. The new bit has also reduced the average number of days to drill the section from as low as 6 days to reach TD instead of 20 days. Performance gains were achieved both in ROP and footage totals in the most challenging formations, including Alam Al Buwaib, Upper Safa, and Lower Safa. The authors will discuss the benefits of this industry collaboration that achieved exceptional performance improvement leading to dramatic cost savings in the Obayied field.



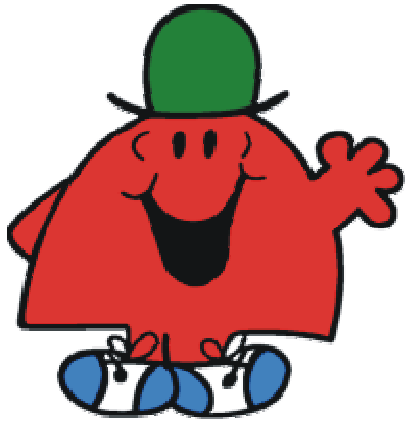


# Pairwork

Describe this graph for student B to draw. Then draw the graph that student B describes.



Btu = British Thermal Unit



# Pairwork

## Student B

*Read this incident report . Student A will ask you some questions. Be ready to answer his/her questions.*

On 23 February 1999 a fire occurred in the crude unit at Tosco Corporation's oil refinery in Martinez, California. Workers were attempting to replace piping attached to a 150-foot-tall fractionator tower while the process unit was in operation. During removal of the piping, naphtha was released onto the hot fractionator and ignited. The flames engulfed five workers located at different heights on the tower. Four men were killed and one sustained serious injuries.

## Student B

*Read this incident report . Student A has got the missing information. Ask him/her questions to find out.*

BP plc said a crude distillation unit (CDU) caught fire on \_\_\_\_\_ at the Lingen refinery in \_\_\_\_\_. One person was \_\_\_\_\_. "The fire was brought under control in \_\_\_\_\_ minutes and damage was contained to that unit, \_\_\_\_\_ said. "The CDU that caught fire has been shut down but the refinery has a second CDU that remains operational", BP said. The fire broke out while \_\_\_\_\_.