BEHIND ENERGY

Energy@School

Guide for teachers

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BEHIND ENERGY

Behind Energy (www.behindenergy.com) is a project whose aim is **to reveal the true costs of energy and promote energy transparency**. It is a "hub" where news, researches, international documents and studies dealing with energy are gathered and classified according to specific criteria: the impact of energy policies on society, economy, environment and citizens.

Considering that today many people have still little when not any access to electricity, and that the world's population is growing, energy consumption will increase significantly over the next years. Nowadays energy supply and independence have become crucial matters of discussion for governments, scientific institutions and media, since they represent the basic requirements for our social and economic development.

During the 20th century fossil fuels represented great opportunities of development for the world, though creating negative externalities for the entire mankind, one above all was the greenhouse effect. Energy availability is probably the most important issue for the 21st century, and there are still some questions to answer: how long will we be able to satisfy the increase of energy demand through traditional sources? Will it be possible in the near future to supply all the inhabitants of the world with the same energy now available to the most developed countries? Can we really do that without creating further externalities? As the Austrian mathematician and physicist Ludwig Boltzmann affirmed, "the struggle for survival is the struggle for available energy…". The question is: how much will we pay for that survival?

Behind Energy proposes an overall reasoning on energy, based on the concept of **externality** – defined as the positive or negative effect that a productive or consumptive activity of any economic subject produces on the productive or consumptive activity of another, but not resulting on the prices paid by consumers – with the intent of providing a general overview containing not only the costs of energy production, but also the economic effects of pollution, energy safety, health etc.
Behind Energy wants to have a ***super partes*** approach, where facts and data are reported in order to move our reasoning on energy from an ethic to an economic/pragmatic dimension, and invite users to reflect upon the true costs of energy, taking into consideration all those costs that today are not considered.

We believe that this is the only way to face the problem properly and **a starting point to make the young people reflect more deeply on such an important matter – energy – which is full of consequences on our lives.**

WHY "ENERGY@SCHOOL"

How much for a kilowatt-hour of energy?

Does it have the same price whether it comes from a coal or gas-fired power station or a wind farm? It is difficult to answer these questions, because there are many implications hidden behind the production of electricity, which are much more complex than we might imagine.

One of the reasons why it isn't easy to answer such questions is because **the world of energy is complex** and full of variables and implications, especially if we want to understand the **true costs of the civil, environmental, economic and social impacts of energy policies**, that usually do not include **economic subsidies**.

Since the number of people that today have little or no access to electricity will decrease by 2040, over the next years the growth of the world's population will inevitably increase the demand of energy consumption.

The problem of energy impacts will become more and more urgent. Which will be the consequences? Who will pay for the negative effects due to an increased production and consumption of energy?

The answer is obvious: today governments and citizens pay for the impacts on health and environment, for the energy wars and the subsidies to energy sources. Such environmental damages tend to be irreversible and all their costs will be paid by our future generations.

The **"Energy@School"** project, **designed for the 1st and 2nd grade secondary schools**, does not only want to discover the true costs of energy, but it aims at promoting a deeper interest and desire of understanding among young people, those who will eventually pay for the environmental externalities caused by the production and use of energy.

In our opinion it is highly important to talk about energy at school. But, instead of using a traditional teaching approach, we involve students in a multidisciplinary project to help them understand the consequences of the different energy policies of countries, and of our habits and lifestyles, as well as the possible future outcomes, in order to make students **more sensitive to such matters and conscious of their behaviour**. It is a way to promote **a different and more sustainable approach** towards the environment and society.

Moreover, the project reveals many **professional opportunities offered by the energy sector,** through specific educational programs and new professional careers, that might become future jobs for the students.

THE PROJECT

The **"Energy@School"** project has been designed as a course for students, focused on the impacts of energy consumption. The project talks about energy from a different perspective, often unusual in ordinary teaching and that requires a specific teachers' training, in order to enable them deal with such matters at school.

"Energy@School" has been organized as a support tool for teachers, useful to treat the subject of energy in class within its recent environmental, social and economic context.
It includes the following materials:

- Teachers' guide, Further information, Places to visit
- PowerPoint Presentations
- Teaching worksheets
- Energy test

Guide for teachers

This guide provides teachers with a **picture of the current energy context**, in order to help them **understand the present situation of the sector** and the possible future scenarios and challenges. A future where those who are students now, will be responsible for our next development, which is not possible without energy and its inevitable implications, from the environment to the economy and society.

Resources

To complete the teachers' guide, we have issued a paper containing various sources of information classified by type (websites for information and update, graphic info, interactive websites, videos, where to go) and including a brief description of each source together with its reference target.

Places to visit

A brief guide of museums and projects regarding energy, designed for young students.

PowerPoint presentations

There are two different PowerPoint presentations: one for the 1st grade secondary students and the other for the 2nd grade secondary students.

The presentation starts by analysing the current situation of the international energy market and identifying the main countries importing and exporting fossil fuels, in particular oil and coal. It then explains how the global energy production and the role of renewable sources will develop by 2040. The presentation continues with a focus on **"the truth on energy numbers"**, that means all the things we do not know or cannot understand regarding the current energy context. In other words,

what are the consequences on economy, environment and society of an energy production and consumption mainly based on fossil fuels? Is it truly necessary to move to an economy based on lower standards of carbon?
After introducing **the concept of externality linked to energy**, the presentation highlights what are **the main effects of negative externalities**, such as the wars caused by the management of fossil sources in the production of energy, the environmental disasters, the premature deaths due to pollution, the climate change as well as the subsidies given by governments to energy sources.

The program includes a reflection on the costs of such development model and on who will be paying for them. The answer is clear: citizens are now paying the consequences of conflicts, pollution and premature deaths, both directly and indirectly through public money. Tomorrow it will be the turn of our future generations.

Nevertheless, **something is changing**. Global institutions are realizing that a change of attitude is necessary, that even though energy is fundamental for our development, new technologies can help us produce and consume it in a more efficient way lowering the emissions of greenhouse gases.

A fundamental role in this new perspective is paid by the international agreements, the policies for disinvesting in fossil fuels and investing in the ever more competitive renewable technologies, the concepts of energy efficiency and electric mobility. If on one hand this new development model requires a huge effort from countries and political and industrial institutions, on the other it offers new perspectives of economic development and new professional opportunities.

Teaching worksheets

The teaching worksheets contain a deeper analysis of the issues regarding renewable sources, fossil fuels, externalities and climate change, together with an overview on some new scenarios, such as the international agreements on greenhouse gas emissions, the new investment/disinvestment trends in the energy sector, energy efficiency, sustainable mobility and green jobs.

Energy Test

Final tool of the presentation is the Energy Test, designed to verify the level of knowledge acquired by students after attending in class the presentation of the "**Energy@School**" project.
There are two types of test, one for the 1st grade secondary schools and the other for the 2nd grade secondary schools. The Energy Test is complete with solutions and details on the sources of information.

ENERGY CONTEXT

The recent energy context has been characterized by the following **distinctive elements**:

- A drastic decrease in oil prices
- The coal crisis, that has meant bankruptcy for some big mining companies and closure of coal-fired plants
- An increase of energy demand in China and India
- The necessity of reducing global greenhouse gas emissions to restrain climate change, and commit to the International agreements aimed at reducing emissions
- A further development of renewable sources and energy efficiency as possible solutions to reach energy independence and restrain dangerous emissions

Oil

Oil prices have decreased drastically in the recent years, sharing such trend in many parts of the world with other fuels like coal and natural gas. In 2014 oil price, after touching its peak of little over 140 dollars per barrel, went through a new period of decrease, with WTI at its minimum of 27 dollars.

Over the years, technologies have advanced and the cost of oil extraction has diminished. The spread of **fracking**, a technique for extracting oil from rocks, has launched the industry of **shale oil**, which has spread dramatically in a few years.

As a consequence, the US has increased its domestic oil production and is now able to fulfill domestic needs itself, thus provoking depreciation and imbalance between global demand and offer.

Some countries like India and Indonesia have taken advantage of the oil price decrease by continuing their programs to **eliminate subsidies for fossil fuels**.

Fracking

In geotechnics hydraulic fracturing or *fracking* is a technique that uses the pressure of a fluid, usually water, to fracture subsoil rocks. Fracturing is done after drilling rocks that contain hydrocarbons, in order to increase their permeability and improve the production of oil or natural gas contained in the well, and enhance the rate of their recovery.

Hydraulic fracturing is under International scrutiny because of the risks of underground water contamination and air pollution. Some countries have suspended or even banned the use of this technique. Hydraulic micro-fracturing can sometime cause the triggering of small and locally restricted earthquakes, whose intensity is usually limited. Nevertheless , when sediments are on surface, there can be local problems of ground stability.

Shale oil

Shale oil is an unconventional oil produced from oil shale rock fragments by pyrolysis, hydrogenation or thermal dissolution. These processes convert the organic matter within the rock (kerogen) into synthetic oil and gas. The resulting oil can be used immediately as a fuel or upgraded to meet refinery feedstock specifications by adding hydrogen and removing impurities such as sulfur and nitrogen. The refined products can be used for the same purposes as those derived from crude oil.

In response to rising petroleum costs at the turn of the 21st century, extraction operations have commenced, been explored, or been renewed in the United States, China, Australia and Jordan. Today the production of shale oil is hindered because of technical difficulties and costs.

Coal

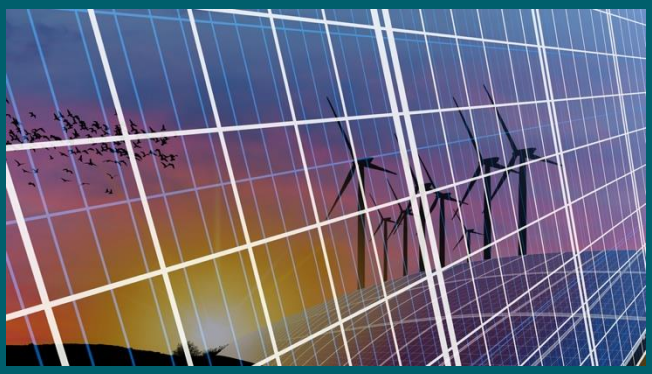
The percentage of coal within the global energy mix has increased from 23% in 2000 to 29% today, but the context that caused such increase has changed, together with the environmental policies on CO_2 emissions, and this is slowly producing a decrease in consumption.

Lately, expectations of a continuous and strong increase of demand, especially in China, has boosted investments in coal production, but the increase has been lower than expected and this has produced a surplus of capacity and a fall in prices.

In the last decade, coal represented 45% of the increase of global energy demand, but **from now until 2040** it will only cover **about 10% of expected growth** in particular in India and South East Asia. In the same period of time, in the OECD countries, where policies are strongly against coal, its demand is expected to diminish by 40%, and in 2040 coal consumption in the European Union will be about a third of its current level. In 2040 Asia will cover 4/5 of global coal demand, due to its electricity system being based mainly on coal.

Renewable sources

The electricity sector is leader in the process of reducing carbon emissions. Electricity is spreading in many end uses and in 2040 it will represent a fourth of the final energy demand.



In 2015 the production capacity from renewable sources expanded by 152 GW (+8,3% compared to 2014) and according to the International Renewable Energy Agency (IRENA) this represents the highest annual rate of growth ever registered.

At the end of 2015 global electricity production capacity from renewable sources was 1.985 GW with an increase of about one third over the last five years. Most of that increase comes from new wind and solar installations.

Over the next 25 years, according to the International Energy Agency (IEA), **renewable technologies will represent 60% of investments in new plants** and the world's energy production from renewable sources will increase by approximately 8,300 TWh (more than half of the increase of the total electricity generation), equalling the current combined production of all the fossil fuel power stations of China, the US and European Union. **Development of renewable sources will essentially reduce the use of coal and oil**, whereas gas, nuclear and hydroelectric sources will keep their current percentage of production. By 2040, electricity production from renewable sources will reach 50% of the total in EU, about 30% in China and Japan, and over 25% in the US and India.

Subsidies to energy sources

Fossil fuels still benefit from **huge subsidies**. **The global amount of such subsidies in 2014 was 500 billion dollars**, and it could have increased up to 600 billion if it wasn't for the reforms launched in 2009. That explains why fossil fuels have lower prices than they should based on their real costs, and are therefore advantaged compared to other energy sources.

By eliminating subsidies, we could remove a distorting element in the energy market. We could create a perfect context to develop the renewable market and boost energy saving. In many countries the renewable sector still suffers from unfair competition with fossil fuels, which is in fact mainly due to subsidies.

In 2014, 120 billion dollars in subsidies were given to support renewable technologies, a quarter of the amount given to fossil fuels. A 50% increase in subsidies, for a total amount of 170 billion dollars by 2040, would guarantee a fivefold increase in the electricity production from non-hydroelectric renewable sources. Over the next years the amount of non-hydroelectric renewable sources that would be competitive without subsidies is expected to double and reach one third of the total amount.

Access to energy

Today 1.2 billion people – 17% of the world's population – **have no electricity**, and 2.7 billion – 38% - risk their lives by using traditional solid biomass (wood) to cook and heat their houses.

The Sustainable Development Goals issued by the UN for the period 2015-2030 include energy, and aim at a **universal access to energy by 2030.**

In 2030 the number of people without electricity should decrease to 800 billion, while the number of people who cannot use clean fuels to cook will gradually diminish to 2.3 billion. **The fulfilment of such goals could save 4.3 million lives a year**. That is in fact the amount of premature deaths caused by the pollution of stoves burning animal waste, kerosene, wood or coal, used by 3 billion people on earth.

Development forecasts for the energy demand

According to IEA data, global energy demand will increase by a third by 2040, with such increase mainly registered in India, China, Africa, Middle East and South East Asia. The estimated increase of global consumption will be driven by non-OECD countries, whereas OECD countries will register a general reduction of energy demand compared to their peak of 2007, because of their demographic trends, a new economic context and a higher level of efficiency. The European Union will lead such decrease with a -15%, followed by Japan (-12%) and USA (-3%).

Commitments made by many countries to reduce emissions will boost the use of sources and technologies with lower levels of carbon, and that would increase the current percentage of non-fossil sources from 19% to 25% in the global energy mix by 2040. Among fossil fuels, only natural gas will increase its percentage in the energy mix.

China and India

The role of **China** in the global energy trend is slowly changing and reducing its portion of global energy demand. The country is in fact entering a new phase of development characterized by a **lower energy intensity** (measure of the energy efficiency of a nation's economy, calculated as units of energy per unit of GDP).

Although China is the country with the highest growth of renewable sources, it is still the **world's main producer and consumer of coal**. In 2030 it will be the world's first consumer of oil, surpassing the USA, while its gas market will become bigger than the European Union's. The Chinese economy is privileging the service sector rather than the heavy industry and local policies are changing the country's energy system and its rhythm of expansion, trying to reduce energy demand. Nevertheless, in 2040 China's energy demand will double USA's.

Today, 50% of China's energy demand – only 3% in 2005 - is subject to compulsory standards of energy efficiency. The vast expansion in wind, solar, hydroelectric and nuclear sources will bring to a balance in CO_2 emissions, reaching their peak around 2030.

In 2040 India will account for a quarter of the global energy demand, thus leading the top list of **the most energy consuming countries**. Today India is one of the world's top 10 economies, but its energy needs represent only 6% of the total and one fifth of its population – about 240 billion people – has no electricity. Thanks to its economic development policies and demographic growth, the country will drastically increase its energy consumption over the next 25 years.

In 2040 India's coal demand for the production of electricity and the industry will grow, covering 50% of the global energy mix, and putting the country at the top list of the world's coal consumers. Even though oil demand will also grow, there will be a vast spreading of technologies with lower standards of carbon emissions, such hydroelectric, nuclear, solar and wind technologies. That will enable India to score its target of 40% of electricity production from non-fossil fuels by 2030.

According to the IEA, meeting India's energy needs will require huge capital investments and extreme care for the implications on environment and energy safety.