Міністерство освіти і науки України

НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
«ОДЕСЬКА ПОЛІТЕХНІКА»

Кафедра іноземних мов

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за спеціальністю

141 «Електроенергетика, електротехніка та електромеханіка»

Одеса
Одеська політехніка
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Затверджено
на засіданні кафедри
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Одеса
Одеська політехніка
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Методичні вказівки до практичних занять з професійної англійської мови за спеціальністю 141 «Електоенергетика, електротехніка та електромеханіка» для здобувачів другого (магістерського) рівня вищої освіти / *Укл.: Н.О.Коваль, Л.Ю. Цапенко, О.В.Гвоздь, О.В. Лебедєва* – О. Одеська політехніка :, 2024.- 59 с.

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ПЕРЕДМОВА

Методичні вказівки до практичних занять з англійської мови призначені для здобувачів II рівня вищої освіти . спеціальності 141 ‘Електоенергетика, електротехніка та електромеханіка ‘; Освітня програма **Відновлювальні джерела енергії та енергокомплекси**
Метою Методичні вказівки є взаємозв’язане формування у здобувачів вмінь та навичок в різних видах мовної комунікації (читання, письма та говоріння англійською мовою) відповідно до Програми за тематикою включених напрямків.
За рахунок тренування в читанні текстів і виконання завдань комунікативного характеру здобувачі підвищують рівень практичного володіння англійською мовою за напрямком з рівня B1 до рівня B2 (за критеріями Документа Ради Європи «Загальноєвропейські компетенції володіння іноземною мовою: Вивчення, викладання, оцінка» - CEFR), що дає можливість: вільно читати оригінальну літературу іноземною мовою у відповідній галузі знань; оформляти витягнуту з іноземних джерел інформацію у вигляді перекладу або резюме; робити повідомлення і доповіді іноземною мовою на теми, пов'язані з науковою роботою майбутнього фахівця; вести бесіду за напрямком.

Методичні вказівки містять 15 основних циклів (Units), об єднаних за тематикою вказаних напрямків і є ідентичними у структурному відношенні. Цикли складаються з 15 автентичних текстів та комплексу мовних вправ, які розраховані на удосконалення навичок активізації словарного і грамматичного мінімуму професійного спрямування.

Автори.

LESSON 1
ALTERNATIVE ENERGY SOURCES

Exercise 1. Read, translate and memorize using a dictionary:

alternative energy sources	global warming
renewable energy	nuclear power generation
non-renewable energy	waste
fossil fuel(s)	by-product
energy consumption	nuclear power
combustion	net emission
environment	carbon
environmental impact	to replenish
air pollution	to deplete
greenhouse gases	obvious

Exercise 2. Read the text:

In our modern industrial society we consume vast amounts of energy to make our daily life more comfortable and productive. We use energy every day - for heat and light in living and working areas, cooking, transportation, manufacturing, and entertainment. The choices we make about how we use energy impact our environment and our lives.

Energy comes from several different sources. These sources can be split into two main categories: non-renewable and renewable. Non-renewable types of energy include the three major types of fossil fuels – coal, oil and natural gas. Fossil fuels supply more than 90% of the world's energy. Oil leads with a share of about 40 % of total world energy consumption, followed by coal (24%) and natural gas (22%).

Fossil fuels are relatively easy to use to generate energy because they only require a simple direct combustion. However, a problem with fossil fuels is their environmental impact. Not only does their excavation from the ground significantly alter the environment, but their combustion leads to air pollution. Carbon dioxide (CO_2) from burning fossil fuels is the largest source of greenhouse gases from human activities. Extra greenhouse gases are causing global warming and climate change. Besides, these are fuels that are being consumed more rapidly than they are being replaced. That means that someday we could run out of these fuels.

Another non-renewable source is uranium. Uranium is an element that gives us nuclear energy by splitting an atom's nucleus, and this process is called fission. Nuclear energy is a better source of energy because it doesn't put carbon dioxide into the atmosphere. But like all industrial processes, nuclear power generation has by-product wastes: radioactive products and heat. Hazardous wastes and the possibility of a nuclear disaster are the principal concerns for nuclear power.

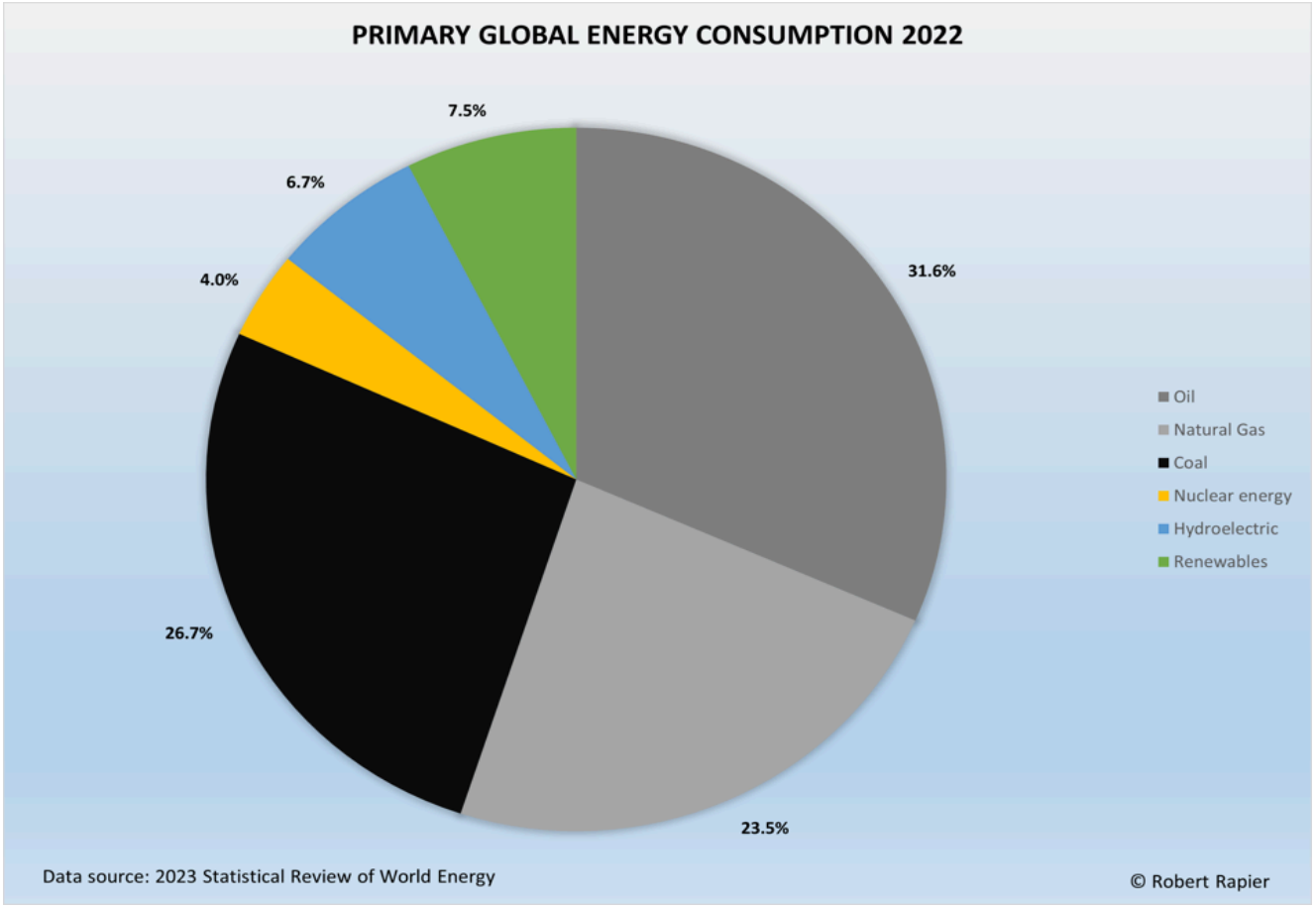
With the growing concerns over the environmental problems today (air pollution, global climate change, etc.) and the price of non-renewable energy sources soaring, we have to take a closer look at the alternative energy sources. Alternatives to the fossil fuels and nuclear power are renewable sources of energy and they are considerably more attractive in many ways. Renewable sources are derived and replenish quickly from nature and usually do not pollute our environment when used to generate electricity. The five renewable sources used most often include hydropower, solar, wind, biomass, and geothermal.

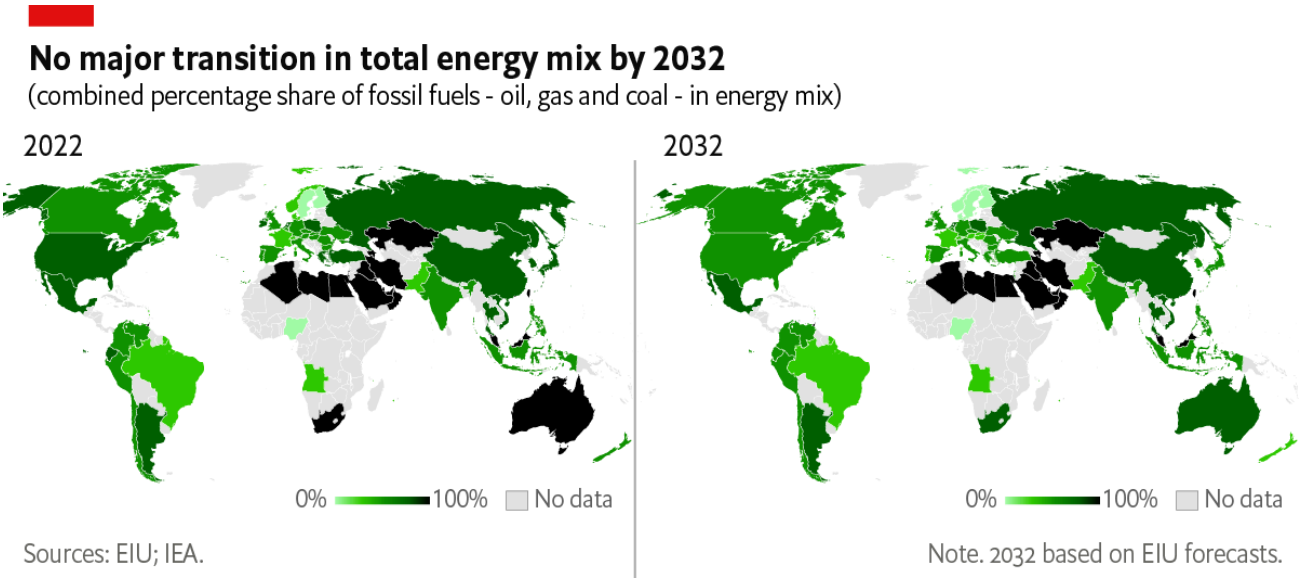
Alternative Energy and Renewable Energy Sources

Energy Suppliers offer consumers a part in the greening of society by deriving their energies from renewable or alternative sources and in some cases they will support environmentally friendly projects. The terms renewable and alternative do not necessarily mean the same thing but the distinction is blurred. There are two main objectives in this context, the most obvious of which is to reduce the net emission of greenhouse gases, especially carbon. The other is that the resources should remain constant and not run out in any foreseeable future.

'Renewable' energy implies that it is derived from a source which is automatically replenished or one that is effectively infinite so that it is not depleted as it is used. The term 'Alternative' refers to energy sources which could replace coal, traditional gas and oil or their close derivatives, all of which increase the atmospheric carbon when burned as fuel.

It is evident why the terms alternative and renewable are often considered to be interchangeable but the concepts are sometimes ambiguous. However, the term **'renewable'** is preferable and any sources that are renewable are also alternative.





Exercise 3. Answer the questions:

1) Why do we consume energy?
2) What are the major types of fossil fuels?
3) In what way is nuclear energy obtained?
4) Why do we have to take a closer look at alternative energy sources?

Exercise 4. Match the left part with the right:

1. Fossil fuels include	a) automatically replenished or effectively infinite
2. Sources of energy include	b) coal, oil and natural gas
3. Alternative energy sources are	c) non-renewable and renewable ones
4. Renewable energy sources are	d) those that can replace traditional coal, oil and gas

Exercise 5. Describe *fossil fuel, renewable energy, air pollution, greenhouse gases, global warming, photovoltaic* using the suggested words and expressions as in example:

fossil fuel
hydrocarbon; natural gas; may be used; Any; examples; deposit; that; for fuel; petroleum; are; coal; and
example:
Any hydrocarbon deposit that may be used for fuel; examples are petroleum, coal, and natural gas.

renewable energy
from; a; such as; the; wind; source; sun; natural; A form; tides; waves; or; derived; of; energy;

air pollution
in; the; atmosphere; or; animal; presence; outdoor; of; to; The contaminants; injurious;; human, plant, life

greenhouse gases
can absorb; planet's surface; the infrared radiation; Some; that; emitted by; the; gases

global warming
believed to be caused by; An increase; the; temperature; worldwide; average; greenhouse effect; in; the

photovoltaic
visible; by; Energy; to; exposure; radiation; or; of; electromagnetic; or; caused; voltage; in; current; the form

Exercise 6. Ask questions to the given answers:

1) Question: _____ ?
Answer: A problem with fossil fuels is their environmental impact.
2) Question: _____?

Answer: Hazardous wastes and the possibility of a nuclear disaster are the principal concerns for nuclear power.

3) Question: _____?

Answer: The term 'Alternative' refers to energy sources which could replace coal, traditional gas and oil.

Exercise 7. Complete the sentences with the suggested words: *are, the other, not, in, to*

The terms renewable and alternative do _____necessarily mean the same thing but the distinction is blurred. There ____two main objectives in this context, the most obvious of which is _____reduce the net emission of greenhouse gases, especially carbon. _____is that the resources should remain constant and not run out _____any foreseeable future.

Exercise 8. Fill in the table with words and expressions from the text:

	fuels	categories	energy sources
Example: Alternatives to the fossil fuels are			renewable sources of energy.
Energy sources include			
Coal, oil and natural gas are			
Renewable sources are			

Exercise 9. Compose a story on one of the topics (up to 100 words):

“The Ways of Using Energy”
“Renewable and Non-renewable Energy Sources”
“World Renewable Energy ”

LESSON 2
SOLAR ENERGY.

Exercise 1. Read and memorize using a dictionary:

solar energy	long-wave infrared radiation
radiant energy	conventional fuel
commercial fuel	heating
nuclear fusion reaction	artificial lighting
relative power density	solar collector
ultraviolet radiation	solar photovoltaic technology
wavelength	semi-conducting material

Exercise 2. Read the text:

Solar energy makes an enormous but largely unrecorded contribution to our energy needs. It is the sun's radiant energy that maintains the Earth's surface at a temperature warm enough to support human life. But despite this enormous input of energy to our civilization, the sun is virtually ignored in national and international energy statistics, which are almost entirely concerned with consumption of commercial fuels.

The sun has a surface temperature of 6000°C, maintained by continuous nuclear fusion reactions between hydrogen atoms within its interior. These nuclear reactions will gradually convert all of the hydrogen into heavier elements, but this is a relatively slow process and the sun should continue to supply power for another 5 billion years.

The sun radiates huge quantities of energy into the surrounding space, and the tiny fraction intercepted by the Earth's atmosphere, 150 million km away, is nonetheless equivalent to about 15,000 times humanity's present rate of use of fossil and nuclear fuels. Even though approximately one-third of the intercepted energy is reflected away by the atmosphere before reaching the earth's surface, this still means that a continuous and virtually inexhaustible flow of power amounting to 10,000 times our current rate of consumption of conventional fuels is available in principle to human civilization.

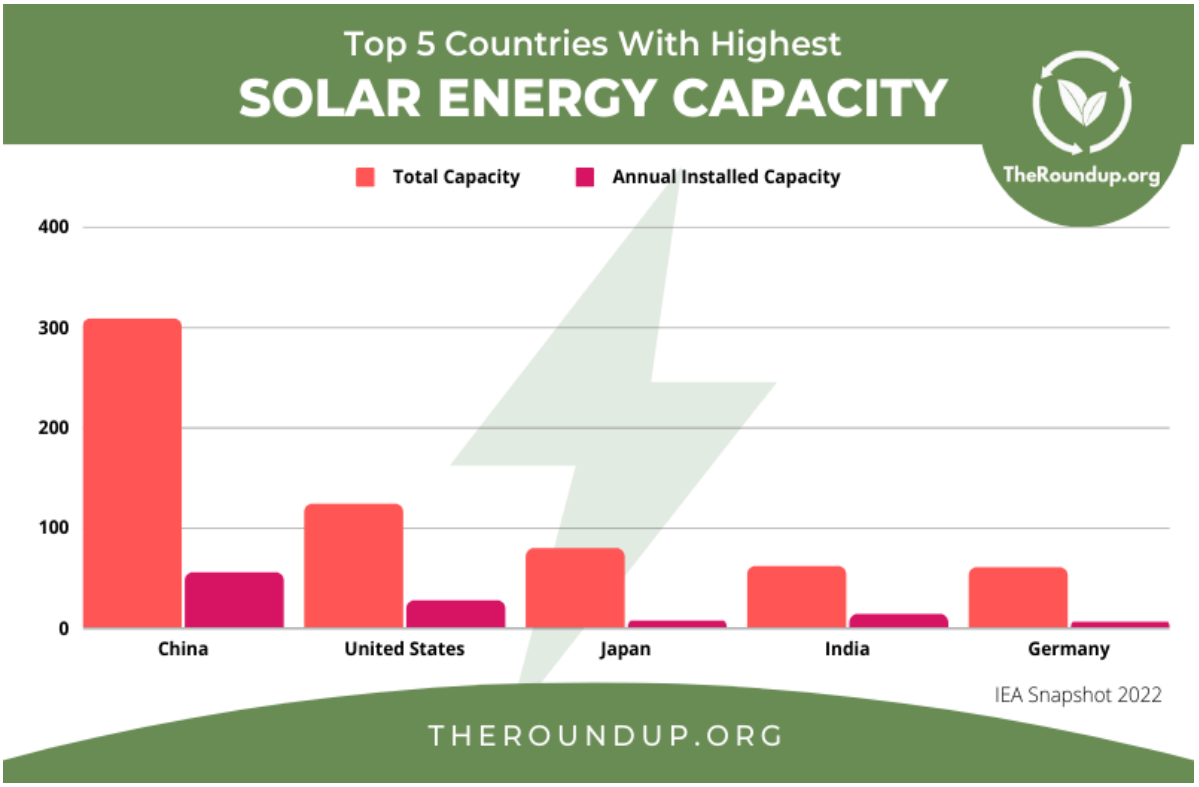
Solar energy, when it enters our buildings, warms and illuminates them to a significant extent. When buildings are specifically designed to take full advantage of the sun's radiation, their needs for additional heating and for artificial lighting can be further reduced.

Solar power can also be harnessed by using solar collectors to produce hot water for washing or space heating in buildings.

Such collectors are in widespread use in sunny countries such as Israel and Greece, but are also quite widely used in less sunny places such as Austria. Even in cloudy Britain there are more than 40,000 roof-top solar water heating systems.

Harnessing solar energy to provide electricity directly involves the use of a different and more sophisticated technology called solar photovoltaics (PV). Photovoltaic ‘modules’ are made of specially-prepared layers of semi-conducting materials (usually silicon) that generate electricity when photons of sunlight fall upon them. Arrays of PV modules are normally mounted on the roofs or facades of buildings, providing some or all of their electricity needs.

Photovoltaic technology is growing very rapidly and several countries have initiated major development and demonstration programmes.



Photovoltaics may well make a significant contribution to world needs in coming decades, but at present its share of world consumption is extremely small. This is mainly due to the very high cost of PV modules, which are currently produced in relatively small quantities. Studies have shown that if the annual output of the manufacturing plants that produce PV modules were increased by a factor of about 20, the cost of PV-generated electricity could be reduced to a point at which it would be competitive with electricity from conventional sources in many industrialised countries.

Exercise 3. Answer the questions:

1) Is the sun's radiation temperature warm enough to support human life?
2) In what way is the sun's surface temperature maintained?
3) How can solar power be harnessed?
4) What are photovoltaic modules made of?

Exercise 4. Match the left part with the right:

1. Solar energy makes	a) by continuous nuclear fusion reactions
2. Photovoltaic modules are made of	b) the sun's radiant energy
3. The sun's surface temperature is maintained	c) specially-prepared layers of semi-conducting materials
4. The Earth's surface temperature is maintained	d) an enormous contribution to our energy needs

Exercise 5. Describe *solar power, photovoltaic module, conventional fuels, nuclear fusion reaction, solar collector* using the suggested words and expressions:

solar power conversion, energy, sun's radiation, useful, work

photovoltaic module unit/device, capable, generating, voltage, result, exposure, visible, other, radiation

conventional fuels materials, burn, to release, heat energy, for example, coal, oil, uranium

nuclear fusion reaction combination, two, light, nuclei, form, heavier, nucleus, release, some, binding, energy

solar collector installation, designed, gather, accumulate, energy, form, solar, radiation

Exercise 6. Ask questions to the given answers:

1) Question: _____ ?
Answer: Such collectors are in widespread use in sunny countries such as Israel and Greece.
2) Question:_____?
Answer: Arrays of PV modules are normally mounted on the roofs or facades of buildings.
3) Question: _____?
Answer: This is mainly due to the very high cost of PV modules.

Exercise 7. Complete the sentences with the suggested words: *away, about, by, into, times*

The sun radiates huge quantities of energy _____the surrounding space, and the tiny fraction intercepted _____the Earth's atmosphere, 150 million km_____, is nonetheless equivalent to _____15,000 _____humanity's present rate of use of fossil and nuclear fuels.

Exercise 8. Fill in the table with words and expressions from the text:

	chemical elements	devices	materials
Example: Nuclear fusion reactions convert	hydrogen into heavier elements.		
Photovoltaic modules are made of			
Solar power can be harnessed by			
Heating can be done by			

Exercise 9. Compose a story on one of the topics (up to 100 words):

“Human Life and the Sun”
“Harnessing the Solar Energy”

LESSON 3
INDIRECT USE OF SOLAR ENERGY

Exercise 1. Read and memorize using a dictionary:

harnessing of energy
wind energy
wave power
solar radiation
curvature
windmill
wind turbine
installed capacity
offshore wind farm
to derive electricity
electricity consumption
site
renewables
electricity utility

Exercise 2. Read the text:

The above examples illustrate the *direct* harnessing of the sun's radiant energy to produce heat and electricity. But the sun's energy can also be harnessed via other forms of energy that are *indirect* manifestations of its power. Principally, these are bioenergy and hydropower, already discussed above, together with wind energy and wave power.

Wind energy

When solar radiation enters the earth's atmosphere, because of the curvature of the earth it warms different regions of the atmosphere to differing extents – most at the equator and least at the poles. Since air tends to flow from warmer to cooler regions, this causes what we call winds, and it is these air flows that are harnessed in windmills and wind turbines to produce power.

Wind power, in the form of traditional windmills used for grinding corn or pumping water, has been in use for centuries. But in the second half of the twentieth century, and particularly in the past few decades, the use of modern wind turbines for electricity generation has been growing very rapidly. Denmark derives more than 15% of its electricity from wind, and in other countries such as Germany, Spain and the United States of America turbines have in recent years been installed at a rate of more than a thousand megawatts per year.

The largest renewable investment, by far, is the Forsen Vind wind farm, an onshore installation, located in central Norway. The project, which started in 2016, cost £945m to set up and is the second-biggest wind farm of its kind in Europe. Since Forsen Vind began operation, it has more than doubled Norway’s wind power generation capacity. A total of 278 turbines provide 1.05 gigawatts (GW) of clean electricity, or 3,400 gigawatt hours (GWh) a year – enough to power close to 800,000 homes in the country.

At present, most of these turbines have been installed on land. But several countries have ambitious plans to install thousands of wind turbines offshore.

One of the world's largest offshore wind farm is now fully operational, 55 miles off the coast of Yorkshire.The Hornsea 2 project can generate enough electricity to power about 1.3 million homes - that's enough for a city the size of Manchester.

A decade ago renewables made up just 11% of the UK's energy mix. By 2021 it was 40%, with offshore wind the largest componen

On Feb. 4, 2021, production from Ørsted's Horns Rev 2 offshore wind farm in Denmark topped 10 billion kWh.

Exercise 3. Answer the questions:

1) What are the indirect manifestations of sun's power?
2) Where does the solar radiation warm the atmosphere most?
3) How long has wind power been in use?
4) Where are most of wind turbines installed at present?

Exercise 4. Match the left part with the right:

1. Indirect manifestations of sun's power are	a) installed on land.
2. Air-flows from cooler to warmer regions are	b)bioenergy, hydropower, wind energy and wave power
3. Most of wind turbines have been	c) growing very rapidly.
4. The use of wind turbines for electricity generation has been	d)harnessed by windmills and wind turbines to produce power.

Exercise 5. Describe *indirect harnessing of sun's radiant energy; winds; wind power; wind turbine; installed generating capacity; electricity utility* using the suggested words and expressions as in example:

indirect harnessing of sun's radiant energy *sun's energy, via, wave power, bioenergy, hydropower, wind energy, principally* ***example*** *Indirect harnessing of sun's radiant energy can be done via other forms of energy, principally, bioenergy and hydropower, wind energy and wave power*

winds
air, motion, earth's surface, relative, cooler, warmer regions, from.

wind power
derived, from, motion, windmill, wind turbine, energy, through

wind turbine
to convert, electrical energy, into, windmill, advanced type

installed generating capacity
maximum, runoff, electric facility, by, constantly, maintained, utilized, equipment.

electricity utility
facility, generation, electric power, processing

Exercise 6. Ask questions to the given answers:
1) Question: _____?
Answer: At the end of 2001 the world total installed wind generating capacity was over 23,000 MW.
2) Question:_____?
Answer: The wind farm at Carno in mid-Wales is one of the largest in Europe.
3) Question:_____?
Answer: Denmark derives more than15% of its electricity from wind.

Exercise 7. Complete the sentences with the suggested words: *would, off, has, have, too, two*
The UK, ___ ____ ambitious offshore wind power proposals. Britain's first ____offshore wind turbines were installed _____ Blyth harbour in Northumberland in 2000, and sites _____been identified for 13 offshore wind farms that could be built in the coming decade. These _____have a total installed capacity of 1600 MW.

Exercise 8. Fill in the table with words and expressions from the text:

	measures	forms of energy	devices
Example: The Middelgrunden wind farm includes	-	-	20 wind turbines.
Indirect manifestations of sun's energy include			
The total installed capacity is			
The energy of air flows coming from warmer to cooler regions is			

Exercise 9. Compose a story on one of the topics (up to 100 words):

"What is Wind Power?"
"The Use of Modern Wind Turbines for Electricity Generation"

LESSON 4
WAVE POWER

Exercise 1. Read and memorize using a dictionary:

wave power	barrage
oscillating water column	estuary
chamber	inlet
air turbine	sea level
non-solar	capacity
tide	power plant
tidal plant	electricity demand
coastline	wildlife
gravitational pull	underwater turbine
dam	tidal/oceanic current

Exercise 2. Read the text:

When winds blow over the world's oceans, they cause waves. The power in such waves, as they gradually build up over very long distances, can be very great – as anyone watching or feeling that power eventually being dissipated on a beach will know.

Various technologies for harnessing the power of waves have been developed over the past few decades, of which the 'oscillating water column' (OWC) is perhaps the most widely used. In an OWC, the rise and fall of the waves inside an enclosed chamber alternately blows and sucks air through a special kind of air turbine, which is coupled to a generator to produce electricity.

Wave energy technology is not as fully developed as wind power or photovoltaics, but its potential has recently been re-emphasised by several governments, including that of the UK. Rapid advances in developing and demonstrating the technology can be expected over the coming decade.

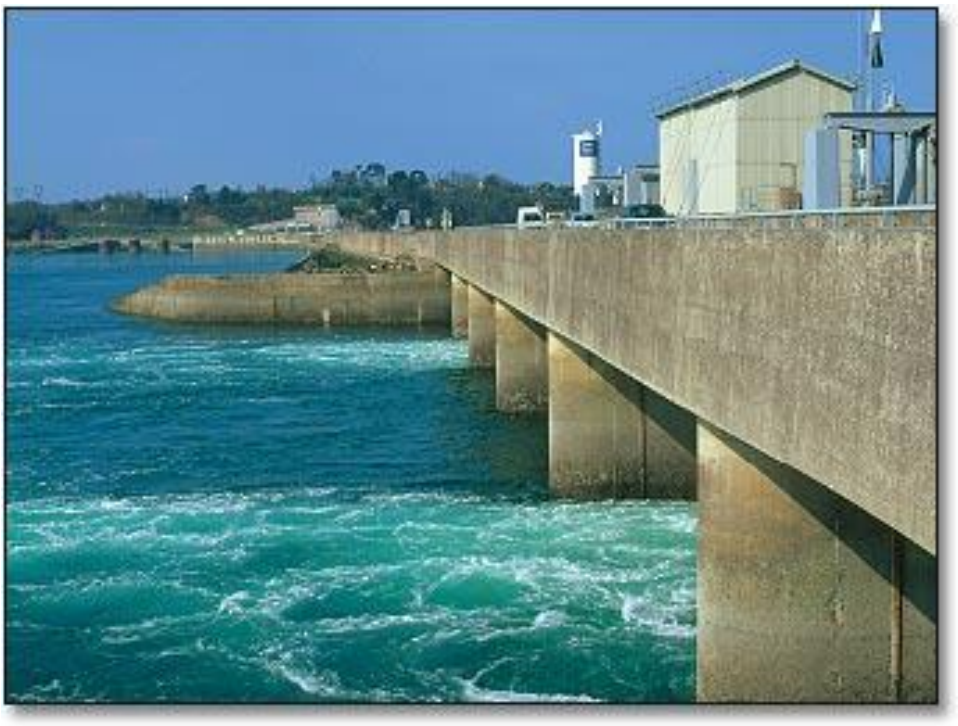
All of the renewable energy sources described above – solar, bioenergy, hydropower, wind and wave – are either direct or indirect forms of solar energy. However, there are two other renewable sources, tidal and geothermal energy, that do not depend on solar radiation.

Tidal Energy

The energy that causes the slow but regular rise and fall of the tides around our coastlines is not the same as that which creates waves. It is caused principally by the gravitational pull of the moon on the world's oceans. The sun also plays a minor role, not through its radiant energy but in the form of its gravitational pull, which exerts a small additional effect on tidal rhythms.

The principal technology for harnessing tidal energy essentially involves building a low dam, or barrage, across the estuary of a suitable river. The barrage has inlets that allow the rising sea levels to build up behind it. When the tide has reached maximum height, the inlets are closed and the impounded water is allowed to flow back to the sea in a controlled manner, via a turbine-generator system similar to that used in hydroelectric schemes.

The 500 kW ‘Limpet’ wave energy plant installed in 2001 on the Scottish island of Islay



The 240 MW tidal barrage installed at the Rance Estuary in France

There are a few other, smaller, tidal plants in various countries, including Canada, Russia and China. The United Kingdom has one of the world's best potential sites for a tidal energy scheme, in the Severn Estuary.

Tidal current technologies – or tidal stream technologies – make use of the kinetic energy of moving water to power turbines, similar to how wind turbines are moved by air. Due to its relatively low cost and limited ecological impact, this method has become more prevalent compared to tidal range technologies.

Unlike wind and solar energy – which are subject to the variability and uncertainty of atmospheric forcing – tidal energy is much more predictable and reliable. Low tide and high tide cycles are easy to forecast and rarely experience unanticipated variation. Long-term and accurate predictions of tidal currents can even be made hundreds of years in advance. In addition, tidal range is hardly influenced by weather conditions. But there are some disadvantages. Locations that are suitable for tidal systems are limited. Tidal energy power plants can only operate along the coastline. Tidal turbines cannot be installed in shallow water with waves-caused turbulence, nor can they be placed in deep water with a lack of current velocity.

Exercise 3. Answer the questions:

1) In what way are waves caused?
2) Which is the most widely used technology for harnessing the power of waves?
3) What is the major cause of regular rise and fall of tides around the coastline?
4) What country has the largest tidal energy scheme?

Exercise 4. Match the left part with the right:

1. Ocean waves are caused	a) the oscillating water column
2. Tides are caused	b) by the winds blowing over the world's oceans
3. Wave energy technology involves	c) by the gravitational pull of the moon on the world's oceans
4. Tidal energy technology involves	d) a low dam built across the estuary of a river

Exercise 5. Describe *water column, tidal current, estuary, electricity demand, wildlife, prototype* using the suggested words and expressions as in example:

water column
tubular, column, locate, steam, water, space, boiler, protective, devices, attach
example:
A water column is a tubular column located at the steam and water space of a boiler to which protective devices (such as gage cocks, water gage, and level alarms) are attached

tidal current
alternating, horizontal, movement, water, rise, fall, tide, caused, astronomical, tide- producing, forces

estuary
semi-enclosed, coastal, body, water, free, connection, open, sea, water, measurably, diluted, fresh, water

electricity demand
ratio, maximum, demand, building, electric, power, total, connected, load

wildlife wild, animals, plants, collectively

prototype model suitable for use in complete evaluation of form, design, and performance

Exercise 6. Ask questions to the given answers:

1) Question:_____?
Answer: There are two renewable sources, tidal and geothermal energy, that do not depend on solar radiation.
2) Question:_____?
Answer: There are a few other, smaller, tidal plants in various countries, including Canada, Russia and China.
3) Question: _____?
Answer: Another, newer tidal energy technology involves the use of underwater turbines to harness the strong tidal and oceanic currents that flow in certain coastal regions.

Exercise 7. Complete the sentences with the suggested words: *one, per, due to, yet, if, would, could*

The United Kingdom has ____of the world's best potential sites for a tidal energy scheme, in the Severn Estuary. _____built, its capacity _____be around 8600 MW, much larger than any other single power plant, and it _____provide about 6 ____cent of current UK electricity demand. But the scheme has not ____been implemented, mainly _____its very high capital cost and concerns about the effects on wildlife in the Severn estuary.

Exercise 8. Fill in the table with words and expressions from the text:

	physical phenomena	devices	countries
<u>Example:</u> A special kind of air turbine is coupled to	-	a generator to produce power.	-
Tidal energy is caused by			
Wind and wave energy depends on			
A 10 kW prototype tidal current turbine was tested			

Exercise 9. Compose a story on one of the topics (up to 100 words):
“Harnessing the Power of Waves”
“Tidal Energy Technologies: Today and Tomorrow”

LESSON 5
GEOTHERMAL ENERGY

Exercise 1. Read and memorize using a dictionary:

geothermal energy	tectonic activity
earth's internal heat	sustainability
decay	replenishment
long-lived radioactive elements	environmental impact
aquifers	world energy needs

Exercise 2. Read the text:

Geothermal energy is another renewable source that is not derived from solar radiation. As the name implies, its source is the earth's internal heat, which originates mainly from the decay of long-lived radioactive elements. The most useful geothermal resources occur where underground bodies of water called aquifers can collect this heat, especially in those areas where volcanic or tectonic activity brings the heat close to the surface. The resulting hot water, or in some cases steam, is used for electricity generation where possible, for example in Italy, New Zealand and the Philippines, and for direct heating use in more than 60 other countries. Geothermal energy is already making a minor but locally useful contribution to world energy supplies.

One of the geothermal power plants at Larderello, Italy, used to provide electricity and hot water

If geothermal heat is extracted in a particular location at a rate that does not exceed the rate at which it is being replenished from deep within the earth, it is a renewable energy source. But in many cases this is not so: the geothermal heat is in effect being 'mined' and will 'run out' locally in perhaps a few years or decades.

Sustainability of renewable energy sources

Renewable energy sources are generally sustainable in the sense that they cannot 'run out' – although, as noted above, both biomass and geothermal energy need wise management if they are to be used sustainably. For all of the other renewables, almost any realistic rate of exploitation by humans would be unlikely to approach their rate of replenishment by nature, though of course the use of all renewables is subject to various practical constraints.

Renewable energies are also relatively 'sustainable' in the additional sense that their environmental and social impacts are generally more benign than those of fossil or nuclear fuels. However, the deployment of renewables in some cases entails significant environmental and social impacts. Renewable energy sources are generally much less concentrated than fossil or nuclear fuels, so large areas of land (or building surfaces) are often required if substantial quantities of energy are to be collected. This can lead to a significant visual impact, as in the case of wind turbines.

Also, the monetary costs of many renewable sources are at present considerably higher than those of conventional fuels. Until this imbalance is reduced, either by reducing the costs of renewables or through increases in the costs of conventional sources, renewables may be unable to succeed in capturing a substantial fraction of the world market.

Renewables may seem attractive in many ways, but how large a contribution might they make to world energy needs in the future?

Exercise 3. Answer the questions:

1) What is the source of geothermal energy?

2) For what purposes is the resulting hot water/steam used?
3) Are the environmental and social impacts of renewable energies more or less benign than those of fossil or nuclear fuels?
4) Are the monetary costs of many renewable sources high compared with those of conventional fuels?

Exercise 4. Match the left part with the right:

1. Geothermal energy originates	a) considerably higher than those of conventional fuels
2. Renewable energy sources are	b) from the earth's internal heat
3. The earth's internal heat originates	c) less concentrated than fossil fuels
4. The costs of renewables are	d) from the decay of long-lived radioactive elements

Exercise 5. Describe *decay, geothermal energy, long-lived radioactive elements, aquifer, sustainability, environmental impact* using the suggested words and expressions as in example:

decay
spontaneous, transformation, nuclide, different, nuclides, accompanied, emission, particles, nucleus, nuclear, capture, ejection, orbital, electrons, fission
Example:
A spontaneous transformation of a nuclide into one or more different nuclides, accompanied by either the emission of particles from the nucleus, nuclear capture or ejection of orbital electrons, or fission.

geothermal energy
thermal, energy, contain, earth; use, directly, supply, heat, convert, mechanical, electrical, energy.

long-lived radioactive elements
element, isotopes, spontaneously, transform, different, nuclides, give off, various, types, radiation; long, period, disintegration

aquifer
porous, deposit, rock, contain, water, use, supply, wells

sustainability
stable, development, environment, preservation, natural, reserves

environmental impact
extent, pollution, environmental, degradation

Exercise 6. Ask questions to the given answers:

1) Question: _____?
Answer: The most useful geothermal resources occur where underground bodies of water called aquifers can collect this heat.
2) Question: _____?
Answer: Geothermal energy is already making a minor but locally useful contribution to world energy supplies.
3) Question: _____?
Answer: If geothermal heat is extracted in a particular location at a rate that does not exceed the rate at which it is being replenished from deep within the earth, it is a renewable energy source.

Exercise 7. Complete the sentences with the suggested words: *out, if, in, both, as, to*

Renewable energy sources are generally sustainable ___ the sense that they cannot 'run___' – although, ____noted above, ____biomass and geothermal energy need wise management ____they are ____be used sustainably.

Exercise 8. Fill in the table with words and expressions from the text:

	countries	physical phenomena	impacts
Example: The source of geothermal energy is	-	the earth's internal heat.	
The deployment of renewables in some cases entails			
Steam and hot water from aquifers are used for electricity generation			
The source of the earth's internal heat is			

Exercise 9. Compose a story on one of the topics (up to 100 words):

"Geothermal Heat: Renewable or not Renewable?"
"Sustainability of Renewables"

LESSON 6
BIOMASS AND COPPICING FOR CHEAP, RENEWABLE ENERGY

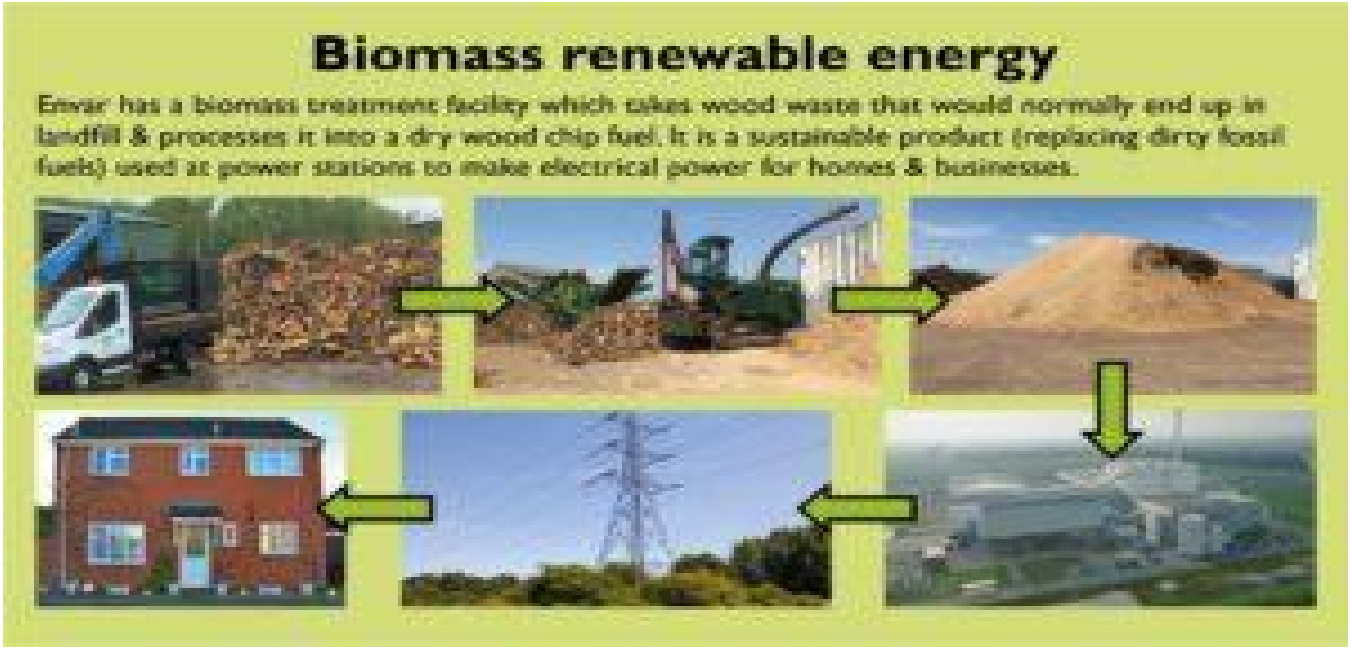
Exercise 1. Read and memorize using a dictionary:

biomass	arfood crops
biofuel	processing
coppicing	cutting
biodiesel	chipping
motor vehicle	pelleting
carbon sinking effect	timber
low tech	landfill
eco-friendly	end-user

Exercise 2. Read the text:

Biomass is a biofuel derived from plants which are harvested and suitably processed for burning. The heat produced is the form of energy which can be harnessed. Other names commonly associated with the technique are Coppicing and Energy Fuel. Biomass is, strictly, a form of biofuel but when we talk about biofuels normally we have in mind biodiesel or ethanol and methanol which are mainly applicable to motor vehicles.

The concept becomes attractive only when the plants are replaced at a rate equal to the rate at which they are harvested. It is argued that the carbon sinking effect of the growing plants neutralises the carbon emitted when the fuel is burnt.



Young trees are better sinks than mature trees. Since the extraction of energy is accompanied by the release of carbon, it is not such an ideal solution as the generation of solar or wind power.

Nevertheless, it provides a renewable source which can be called on no matter what the prevailing weather conditions are and is much more eco-friendly than burning fossil fuels such as coal and oil. Additionally, it can be a cheap option.

Biomass methods are basically low tech and they are particularly useful where there is surplus low-grade arable land. Therefore the system is appropriate, not only for some undeveloped countries, but also for the UK and other parts of Europe where efficient agricultural techniques frequently lead to overproduction of food crops. The potential is attractive because it is relatively cheap (eg compared to

the radical solar, wind, etc schemes). Although the processing requires the input of energy (cutting, chipping, pelleting, transporting etc) it can be quite efficient. Where the location is suitable, for example in rural areas, end-users may have access to logs at negligible expense and others may be able to extract clean (ie untreated) timber from constructors' waste which otherwise may go into landfill.

If this process was developed fully in the UK, it could become a major agricultural industry and would be capable of meeting a significant proportion of the current electrical demands. One of the most practical ways of generating biofuels is to plant fast-growing trees, such as willow, and cut them back every few years, allowing further growth to occur. This is usually referred to as **coppicing** and the fuel is solid wood, often chipped or pelleted. Another method is to grow suitable green plants from which liquid vegetable oil can be extracted.

Biomass implementation is not without its opponents. Apart from the underlying disadvantages that carbon is emitted and there may be toxic products of combustion, some feel that the countryside would be spoiled by the sight of disfigured forests, and there are other legitimate objections such as the hogging of arable land and a reduction in biodiversity.

On the other hand the prospect of a new, significant, cleanish, renewable energy source which is cost effective and which will provide employment is likely to appeal to government and farmers alike. Pelleted wood burners are likely to increase in use in the UK because the fuel should be reliably available and in areas where oil and electricity are the norm the capital outlay can be offset in a few years. In summary biomass has the potential to contribute to carbon reduction, convenience and possibly economic development.

Exercise 3. Answer the questions:

1) What is “biomass”?
2) Where are the biomass methods particularly useful?
3) Which is the most practical way of generating biofuels?
4) What are the underlying disadvantages of biomass implementation?

Exercise 4. Match the left part with the right:

1. Biomass is	a) planting fast-growing trees and cutting them back every few years, allowing further growth to occur.
2. Coppicing is	b) in use in the UK.
3. Pelleted wood burners are likely to increase	c) a biofuel derived from plants which are harvested and suitably processed for burning.
4. The prospect of a new, cleanish, renewable energy source is likely to appeal	d) to government and farmers alike.

Exercise 5. Describe *biomass, carbon sinking effect, processing, chipping, timber, landfill* using the suggested words and expressions as in example:

biomass
dry, weight, living, matter, include, stored food, present, species, population, express, terms, given, area, volume, habitat.
Example:
The dry weight of living matter, including stored food, present in a species population and expressed in terms of a given area or volume of the habitat.

carbon sinking effect
effect, some, extensive, quantity, carbon, absorb

chipping process, reducing, large, pieces, wood, chips.

timber wood, use, building, carpentry, joinery.

landfill special, place, territory, various, waste, garbage, take, keep

Exercise 6. Ask questions to the given answers:

1) Question: _____?
Answer: Other names commonly associated with the biomass technique are Coppicing and Energy Fuel.
2) Question: _____ ?
Answer: Biomass methods are basically low tech.
3) Question: _____?
Answer: Another method is to grow suitable green plants from which liquid vegetable oil can be extracted.

Exercise 7. Complete the sentences with the suggested words: *if, in, would, one, most, to, such as, few*

____this process was developed fully____ the UK, it could become a major agricultural industry and _____be capable of meeting a significant proportion of the current electrical demands. _____of the _____practical ways of generating biofuels is _____plant fast-growing trees, _____ willow, and cut them back every _____years, allowing further growth to occur.

Exercise 8. Fill in the table with words and expressions from the text:

	processes	machines	fuels
Example: Talking about biofuels we mean	-	-	biodisel, methanol and ethanol.
One of the most practical ways of generating biofuels is referred to as			
Ethanol and methanol are mainly applicable to			
Burning biomass is more eco-friendly than burning			

Exercise 9. Compose a story on one of the topics (up to 100 words):

"Biomass as a Biofuel"
"Advantages of Biomass Implementation"
"Disadvantages of Biomass Implementation"

LESSON 7
BIO-DIESEL, A RENEWABLE ALTERNATIVE TO PETRO-DIESEL FOR MOTOR VEHICLES

Exercise 1. **Read and memorize using a dictionary:**

biodiesel
petrodiesel
vegetable oil
cooking grease
heating boiler
greenhouse gases
animal oils/greases
byproduct
sodium
transesterification
fatty acid methyl esters
lubricant
humectant
rapeseed
soybean/palm oil
toxic fumes
wagon
engine

Exercise 2. Read the text:

As its name suggests biodiesel is a fuel oil derived from biological sources. Mainly these are vegetable oils and recycled cooking greases or oils, and it is a viable alternative to traditional petro-diesel for fuelling diesel engines. It has other uses, for example in heating boilers, but our main concern is its use in cars and other motor vehicles. As a motor fuel, it may be used 100% pure (in compatible engines) or combined with petro-diesel in proportions as low as 2%. Although on combustion it releases greenhouse gases (mainly, but not only, CO2) it is described as carbon-neutral, since it is derived indirectly from living plant sources. It is argued that the plants absorb essentially the same amount of these gases during the growing stage and this is in stark contrast to fossil-based fuels. The benefits of biodiesel exceed its carbon-neutral property and some of the other advantages are identified below. Biodiesel can also be manufactured from animal oils and greases for which the arguments are different. However, if these oils and greases are normally discarded then taking them out of the waste stream and converting them to a fuel has obvious, substantial environmental benefits. First let's briefly see how it is manufactured then identify some limitations before identifying its main advantages

How is it manufactured, its byproducts and what does it cost?

Put simply, vegetable and/or animal oils, fats or greases are combined with methanol in the presence of sodium or potassium hydroxide (as a catalyst). The chemical reaction is called transesterification, and the products are fatty acid methyl esters (the biodiesel) plus glycerine. The

latter is an alcohol with many useful properties for example it is sweet, a lubricant and a humectant which means it retains moisture. These properties give rise to many commercial applications in commodities such as drugs, paints, personal-care products, foods, flexible plastics etc. Popular raw sources for biodiesel processing include rapeseed oil (Europe), soybean oil (USA), palm oil (SE Asia). Various cooking oils and fats are suitable (new and recovered). Some keen individuals make their own biodiesel, especially in the States, and there are sites describing the methods, but the chemicals produce toxic fumes and the liquids are corrosive (e.g. caustic soda) so great care is needed. It is possible for individuals to buy small and medium sized purpose-made plant for production. Reading some articles on the net we see examples where experimenters are pouring neat untreated oils into their wagons and claiming to get away without processing, however, there are serious drawbacks to such a method which can result in expensive damage to the engine. The cost of manufacturing biodiesel currently is greater than petro-diesel although with the volatility of conventional oil prices we are not giving a figure. Even so, at the point of sale the difference may be negligible due to the imposition of tax. In the UK, for example, where taxes are high and biodiesel gets some preference the prices of commercially produced diesels are similar. If the biodiesel is home produced it can be significantly cheaper in the tank.

Exercise 3. Answer the questions:

1) What kind of a fuel is biodiesel ?
2) In what way may it be used as a motor fuel?
3) From what products can biodiesel be manufactured?
4) Is the cost of manufacturing biodiesel higher than that of petro-diesel?

Exercise 4. Match the left part with the right:

1. Biodiesel may be used	a) rapeseed oil, soybean oil, palm oil
2. Popular raw sources for biodiesel processing include	b) expensive damage to the engine.
3. The products of transesterificationtion include	c) 100% pure or combined with petro-diesel in proportions as low as 2%.
4. The drawbacks to the method can result in	d) fatty acid methyl esters plus glycerine.

Exercise 5. Describe *biofuel, greenhouse gases, byproduct, transesterification, lubricant, engine* using the suggested words and expressions as in example:

biofuel
gaseous, liquid, solid, substance, biological, origin, used, fuel
Example:
Biofuel is a gaseous, liquid, or solid substance of biological origin that is used as a fuel.

greenhouse gases
emissions, cause, burning, coal, gas, oil, carbon, dioxide

byproduct
product, manufacturing, process, considered, principal, material

transesterification
conversion, organic, acid, ester, another, ester, same acid

lubricant substance, used, reduce, friction, between, parts, objects, relative, motion

engine machine, power, applied, do, work, conversion, various, forms, energy, mechanical, force, motion

Exercise 6. Ask questions to the given answers:

1) Question:_____?
Answer: It has other uses, for example in heating boilers.
2) Question: _____?
Answer: The benefits of biodiesel exceed its carbon-neutral property.
3) Question: _____?
Answer: Various cooking oils and fats are suitable (new and recovered).

Exercise 7. Complete the sentences with the suggested words: *but, in, some, there, so, for, own*

_____keen individuals make their ____biodiesel, especially ____the States, and ____are sites describing the methods, ___the chemicals produce toxic fumes and the liquids are corrosive (eg caustic soda) __great care is needed. It is possible ___individuals to buy small and medium sized purpose-made plant for production.

Exercise 8. Fill in the table with words and expressions from the text:

	substances	devices	commodities
Example: On combustion biodiesel releases	greenhouse gases (mainly CO2).	-	-
Biodiesel is used in			
Biodiesel can be manufactured from			
Glycerine has commercial applications in			

Exercise 9. Compose a story on one of the topics (up to 100 words):

“The Ways of Manufacturing Biodiesel”
“Advantages vs Disadvantages of Using Biodiesel”

LESSON 8
BIO-DIESEL. ADVANTAGES AND DISADVANTAGES.

Exercise 1. Read and memorize using a dictionary:

natural forestation
provision of foods
compression-ignition engines
nitrogen oxide
intake air
tailpipe particulate matter
four-stroke compression ignition engines
hydrocarbon
soot
exhausts
sulphur
acidic precipitation
fringe benefits
raw material
residues
contaminated materials
energy density
viscosity
additive
engine deposits

Exercise 2. Read the text:

There are some limitations to its green credentials.

The carbon-neutral feature of biodiesel can be reduced to some extent because fossil fuels may be used in general transportation and in the manufacturing process. That is a variable depending on the detailed procedures but in any case should not be as much as a third.

Where specialised crops are grown on a vast commercial scale there is a distinct threat to diversity, natural forestation and the provision of foods.

Frequently biodiesel is combined with petro-diesel to ensure greater compatibility with unmodified engines. When used in standard compression-ignition engines biodiesel can increase nitrogen oxide emissions. This phenomenon is not due to nitrogen in the fuel but comes from the intake air as a result of the particular combustion process. This phenomenon is not replicated in some other applications such as oil fired boilers and the effect can be reduced in vehicle engines by refining the tuning. Now let's review some of the additional benefits of biodiesel.

Biodiesel produces less noxious emissions than petro-diesel.

Biodiesel reduces tailpipe particulate matter, hydrocarbon, and carbon monoxide emissions from most modern four-stroke compression ignition engines. The reason is mainly associated with the presence of oxygen in the fuel which allows more complete combustion. Particulates are mainly carbon dust, commonly described as soot, and contain very fine particles that can be dangerous since they can get into the lungs by bypassing the body's natural filter mechanisms. Together with the unburned hydrocarbons, particulates are suspected of being carcinogens and can cause other serious toxic effects. Carbon monoxide is well known for its lethal action in the bloodstream. Obviously, the higher the proportion of biodiesel in a mixture, the more these noxious exhausts are reduced. Biodiesel has a very low concentration of sulphur, which can lead to SO2 and acidic precipitation. The amount is very much less than traditional diesel oils.

And there are other fringe benefits of biodiesel.

The overarching benefit of biodiesel is that as a renewable fuel it is nominally carbon-neutral. An associated factor is that the global petroleum resources are being depleted rapidly and the term renewable is more significant than just reducing emissions. Biodiesel improves the lubricating power of the fuel and therefore ensures correct operation of key components in the engine system.

The fuel can be used in existing diesel engines especially at low proportions. Some modifications may be necessary, especially at higher concentrations of bio, and vehicle purchasers should be aware of engine specifications. The modifications are usually only minor and do not represent a basic change in the technology.

The fact that one possible raw material is used cooking oils etc gives a special advantage. Large caterers (think McDonald's) will have residues contaminated with meat. To be able to use this product for biodiesel is an opportunity to be welcomed, the only downside being that the contaminated materials would need to be filtered and 'washed' first.

Some disadvantages.

Biodiesel has a lower energy density than petro-diesel and because it is a denser fuel, the statistics vary slightly depending on whether you want a figure of energy per gallon or per pound. Roughly speaking the reductions are in the vicinity of 10%. Viscosity at low temperatures is important with diesel, sometimes making cold-weather starting difficult; biodiesel can be at a disadvantage in this respect. We have read of occasional use of dual tank vehicles where petro-diesel is used to start and shut down but switched to biodiesel for main running. A more practical solution is to introduce some special additive or a proportion of petro-diesel.

The properties of biodiesel mean that rubber pipes may have to be replaced by plastic ones and it may remove engine deposits hence filters may need changing more frequently.

If biodiesel-from-crops was widely adopted as a motor fuel then there would be a knock-on effect with serious problems caused by reduced biodiversity, displaced forests and the disrupted supply of other vital agricultural products. There is no reasonable expectation that petro-diesel could be completely replaced by bio-diesel. There are already signs that over development of crops for bio fuels can be damaging to the environment.

Exercise 3. Answer the questions:

1) What are the major limitations of using biodiesel?
2) What are the advantages of using biodiesel?
3) What are the disadvantages of diodiesel?
4) Is overdevelopment of crops for bio fuels damaging to the environment?

Exercise 4. Match the left part with the right:

1. Using biodiesel in standard compression-ignition engines can	a) in existing diesel engines.
2. The unburned hydrocarbons and particulates can	b) increase nitrogen oxide emissions.

3.	Biodiesel can be used	c)	for biodiesel.
4.	Residues contaminated with meat can be used	d)	cause serious toxic effects.

Exercise 5. Describe *nitrogen oxide, hydrocarbon, exhaust, residue, energy density, additive* using the suggested words and expressions as in example:

nitrogen oxide

N_2O, colorless, sweet-tasting, gas, boiling, -90°C; slightly, soluble, water, soluble, alcohol; used food, aerosol, anesthetic, dentistry, surgery, known, laughing, gas

Example:

N_2O Colorless, sweet-tasting gas, boiling at -90°C; slightly soluble in water, soluble in alcohol; used as a food aerosol, and as an anesthetic in dentistry and surgery.Also known as laughing gas.

hydrocarbon

one, very, large, group, chemical, compounds, composed, only, carbon, hydrogen; largest, source, hydrocarbons, petroleum, crude, oil

exhaust

working, substance, discharge, engine, cylinder, turbine, performing, work, moving, parts, machine

residue

substance, left, distilling, heaviest, component, crude, oil, petroleum, refinery, operations solids, deposited, filter, medium, filtration

energy density

energy, per, unit, volume, medium; case, electric, magnetic, field, energy, needed, set up, field, thought, residing, field

additive

substance, added, another, strengthen, otherwise, alter, purpose, improving, performance, finished, product

Exercise 6. Ask questions to the given answers:

1) Question: _____?
2) Answer: Where specialised crops are grown on a vast commercial scale there is a distinct threat to diversity, natural forestation and the provision of foods.
3) Question: _____?
4) Answer: The overarching benefit of biodiesel is that as a renewable fuel it is nominally carbon-neutral.
5) Question: _____?
6) Answer: If biodiesel-from-crops was widely adopted as a motor fuel then there would be a knock-on effect with serious problems caused by reduced biodiversity, displaced forests and the disrupted supply of other vital agricultural products.

Exercise 7. Complete the sentences with the suggested words: *with, as, if, could, there, by, no*

_____biodiesel-from-crops was widely adopted ___ a motor fuel then ____ would be a knock-on effect ____ serious problems caused __ reduced biodiversity, displaced forests and the

disrupted supply of other vital agricultural products. There is ____reasonable expectation that petro-diesel _____be completely replaced by bio-diesel.

Exercise 8. Fill in the table with words and expressions from the text:

	processes	chemical elements	raw materials
Example: Nitrogen oxide emissions are the result of	the particular combustion process.	-	-
Production of biodiesel may need			
Biodiesel has a low concentration of			
Fossil fuels may be used in			

Exercise 9. Compose a story on one of the topics (up to 100 words):

“Benefits of Biodiesel”
“Limitations of Biodiesel”
“Disadvantages of Biodiesel”

LESSON 9
ETHANOL AND METHANOL AS BIOFUELS FOR INTERNAL COMBUSTION ENGINES IN MOTOR VEHICLES

Exercise 1. Read and memorize using a dictionary:

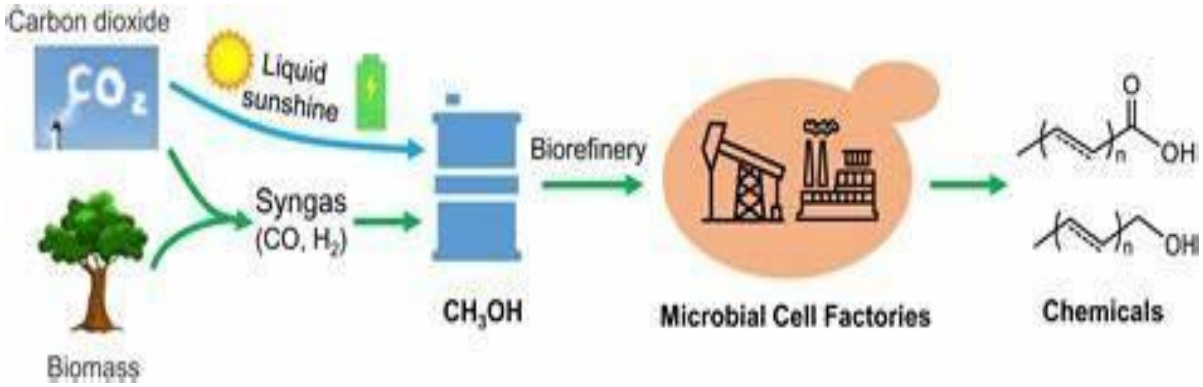
petrol	fuel filter
gasoline	tax concession
denatured alcohol	retail market
poison	sugar cane
warranty	bio-ethanol
octane rating	flexible fuel vehicle
corrosive	filling station
abrasive	alcohol-based fuel

Exercise 2. READ THE TEXT:

Ethanol (ethyl alcohol) and Methanol (methyl alcohol aka wood alcohol) can be used to fuel internal combustion motor vehicles, either as sole fuels or, more usually, when mixed with petrol (gasoline). As a warning, in case you think these alcohols are a cheap way of fuelling your cocktail cabinet, note that this ethanol is of a dangerously high proof and contains additives which make it poisonous (it is referred to as denatured alcohol). Methanol is well known to be a dangerous poison in its own right.

Most contemporary petrol cars will run on E10, a 10% mixture of ethanol to petrol, although warranties may state that a mix of 5% is the maximum allowed. Many major car manufacturers have developed cars which run on fuels containing higher proportions of alcohol, typically E85. Ethanol has some properties which are different from petrol; for example, in car engines, it has a higher octane rating, is more corrosive and abrasive, cleans the old deposits away (hence fuel filters, in converted vehicles, may need changing after a short time, initially), may create minor flow problems and can make starting more difficult. The national distribution network will also require modifications to some of its components, mainly because of the corrosive properties of alcohol and its ability to mix with water.

In the UK, in 2005, tax concessions for ethanol encouraged a minor shift and a 5% ethanol mixture entered the retail market. A firm called *Greenenergy* pioneered this and *Tesco* have been reported as the retailers (mainly in SE England), the ethanol source being Brazilian sugar cane. The real motivation may be cost (although the reduction in price to the UK customer is small) but even so that is no bad thing. In 2006 another supermarket, *Morrisons*, started selling E85 bio-ethanol in East Anglia. The 5% mix can be used in most petrol vehicles but the 85% mix is limited to a very small number of current vehicles. It is hoped that the trend continues with a significant expansion of the use of bio-ethanol in the UK, and other sources will be created.



The estimated energy densities for ethanol and methanol.

When compared to diesel, the energy densities are about 56% and 46% respectively, when compared with petrol (gasoline) the ratios are about 64% and 53%.

The design and adjustment of a *Flexible Fuel Vehicle* (an *FFV* will run on petrol and ethanol) must take these differences into account although the basic technology is not necessarily more advanced. Of course, if you don't have an abundance of suitable filling stations around the country then you can't expect the car manufacturers to supply the cars. Brazil is a country which well known for using alcohol-based fuels but there are others too. It appears that in the USA, farmers can brew their own licensed supplies.

Exercise 3. Answer the questions:

1) In what way can ethanol and methanol be used to fuel internal combustion motor vehicle?
2) Can these alcohols be used for making cocktails?
3) What properties of ethanol differ from those of petrol (gasoline)?
4) What kind of a raw material is used for producing ethanol in Brasil?

Exercise 4. Match the left part with the right:

1.	Ethanol has	a)	on petrol and ethanol.
2.	Methanol is	b)	on a 10% mixture of ethanol to petrol.
3.	Most contemporary cars will run	c)	a higher octane rating.
4.	Flexible fuel vehicle will run	d)	a dangerous poison.

Exercise 5. Describe *gasoline, denatured alcohol, poison, octane rating, abrasive, fuel filter* using the suggested words and expressions as in example:

gasoline
fuel, internal, combustion, engine, consist, essentially, volatile, flammable, liquid, hydrocarbons; derive, crude, petroleum, processes, distillation, reforming, polymerization, catalytic, cracking, alkylation; common, name, gas, petrol.
Example:
A fuel for internal combustion engines consisting essentially of volatile flammable liquid hydrocarbons; derived from crude petroleum by processes such as distillation reforming, polymerization, catalytic cracking, and alkylation; the common name is gas. Also known as petrol.

denatured alcohol
ethyl, alcohol, contain, poisonous, substance, methyl, alcohol, benzene, unfit, human, consumption

poison
substance, relatively, small, doses, action, destroy, life, impair, seriously, functions, organs, tissues

octane rating
rating, indicate, tendency, knock, fuel, use, standard, internal, combustion, engine, standard, conditions

abrasive
have, qualities, conducive, derive, abrasion, known, abradant

fuel filter
device, internal, combustion, engine, remove, particles, fuel

Exercise 6. Ask questions to the given answers:
1) Question: _____?
Answer: Many major car manufacturers have developed cars which run on fuels containing higher proportions of alcohol, typically E85.
2) Question: _____?
Answer: The national distribution network will also require modifications to some of its components, mainly because of the corrosive properties of alcohol and its ability to mix with water.
3) Question: _____?
Answer: When compared to diesel, the energy densities are about 56% and 46% respectively, when compared with petrol (gasoline) the ratios are about 64% and 53%.

Exercise 7. Complete the sentences with the suggested words: *being, as, for, even so, in, although, this, mainly, may*

In the UK, _____2005, tax concessions _____ethanol encouraged a minor shift and a 5% ethanol mixture entered the retail market. A firm called *Greenenergy* pioneered _____ and *Tesco* have been reported ____the retailers (_____in SE England), the ethanol source _____Brazilian sugar cane. The real motivation _____ be cost (_____the reduction in price to the UK customer is small) but _____that is no bad thing.

Exercise 8. Fill in the table with words and expressions from the text:

	compounds	ratios	vehicles
Example: Ethanol and methanol can be used to fuel	-	-	internal combustion motor vehicles
The 5% mix can be used in			
Compared with petrol (gasoline)			
Ethanol contains			
A10% mixture of ethanol to petrol is used in			

Exercise 9. Compose a story on one of the topics (up to 100 words):
“Properties of Ethanol and Methanol Compared with Petrol”
“Motivation for Using Ethanol and Methanol instead of Petrol (Gasoline)”

LESSON 10
BIOFUELS FOR INTERNAL COMBUSTION ENGINES PRODUCTION.

Exercise 1. Read and memorize using a dictionary:

waste
residue
sugar cane
cropping habit
fibrous waste (bagasse)
cogeneration
grid
environmentally relevant
corn mash
animal feed
carcinogen
hazardous pollutant
acetic acid
formaldehyde
volatile organic compounds
fossil extractions
sequestered carbon
monitoring
tail-pipe pollution
exhaust

Exercise 2. Read the text:

It is fairly common knowledge that the alcohols can be made from organic materials such as grains, fruit and wood. In practical and commercial terms the sources may be quite varied and sometimes surprising.

For example, waste from fields (used in food production) can be a useful source. The waste, traditionally, may have been burned but using the residue instead to create fuel gives a two-pronged environmental benefit. Firstly, the burning of the waste that would have fed dirt and toxic compounds into the atmosphere is obviated, and secondly, the use of the new byproduct as a renewable fuel means that less fossil fuel is consumed in vehicles.

There is also a potential for the extraction of alcohols from domestic rubbish or trash. To some extent the advantages are as described above but additionally the amount of waste going in to landfill is reduced.

Sugar Cane is a good example of a raw material which can be cultivated for the purpose of producing alcohol and therefore is different in principle from using already existing material. Other food crops such as corn and potato can be used to produce alcohols but none seem to have the potential of sugar cane. *Dr Andre Faaij* at the *Utrecht University* describes it as a 'Wonder Crop'. Sugar Cane has a very efficient cropping habit and the fibrous waste (bagasse) can be used to power the plant and evaporate the cane juice. This is a prime instance of industrial cogeneration or CHP. Where the cogeneration is efficient it is even possible to sell excess electricity to the the grid. The world's largest producer of ethanol from sugar cane is Brazil but other countries include India and Mauritius and there are more with considerable potential.

The main argument in favour of the process is that the growing of the crops absorbs carbon and so compensates for the eventual emissions. That argument has its doubters but certainly there can be little doubt that this is far preferable to the use of fossil materials.

The *processes* by which alcohols are produced are environmentally relevant. For example in the US, corn mash may be fermented to produce alcohol and the dried residue used for animal feed. In the States, the *Environmental Protection Agency (EPA)* argues that some of these production plants are releasing carbon monoxide, methanol and some carcinogens at unacceptable levels. Methanol is classified as a hazardous pollutant if it is allowed to contaminate the environment, and the emitted carcinogens include formaldehyde and acetic acid, released as *volatile organic compounds* (*VOCs*). It would appear that processes that are not properly controlled could create serious pollutions; so control is important.

There are clearly pros and cons in greenness when sourcing and producing alcohols. What we deduce is that if the sources are materials which are being cultivated or would normally be created anyway (eg waste from food production) there are substantial benefits to be gained. On the other hand if the raw materials are fossil extractions they will release sequestered carbon and that is as bad as it gets. Also we note there is a need for scientific monitoring and control of the production processes.

If alcohols are used instead of petrol is there less tail-pipe pollution?

Here again we don't find an easy answer. Although cars can run on pure alcohol, road vehicles normally use a mixture of petrol and alcohol. The ratio of the mixture makes a difference to the pollution potential. In general when alcohol is added there appear to be less carbon monoxide and other toxins but there are greater emission of VOCs (see above): localized pollution is not only about carbon emissions.

On balance we do believe that the optimum mixture will be slightly greener at the point of exhaust.

Exercise 3. Answer the questions:

1) What can alcohols be made from?
2) What are the benefits of using waste from fields to create fuel?
3) Which is the world's largest producer of ethanol from sugar cane?
4) In what way is methanol classified?

Exercise 4. Match the left part with the right:

The alcohols can be	a mixture of petrol and alcohol.
Waste from fields can be	a useful source.
Road vehicles normally use	be made from organic materials.
Corn and potato can be used	to produce alcohols.

Exercise 5. Describe *cogeneration, grid, carcinogen, acetic acid, volatile, monitoring,* using the suggested words and expressions as in example:

cogeneration
simultaneous, on-site, generation, electric, energy, process, steam, heat, same, plant
example:
The simultaneous on-site generation of electric energy and process steam or heat from the same plant

grid
systematic, network, telephone, lines, power, lines

carcinogen

agent, incite, development, carcinoma, sort, malignancy

acetic acid clear, colorless, liquid, crystalline, mass, pungent, odor, miscible, water. alcohol

volatile readily, passing, off, evaporation

monitoring measure, continuously, intervals, condition, must, kept, prescribed, limits, radioactivity, point, nuclear, reactor, etc

Exercise 6. Ask questions to the given answers:

Question: _____ .
Answer: There is also a potential for the extraction of alcohols from domestic rubbish or trash.
Question: _____ .
Answer: Sugar Cane has a very efficient cropping habit and the fibrous waste (bagasse) can be used to power the plant and evaporate the cane juice.
Question: _____ .
Answer: Although cars can run on pure alcohol, road vehicles normally use a mixture of petrol and alcohol.

Exercise 7. Complete the sentences with the suggested words: *as, from, above, also, or, to*

There is ____a potential for the extraction of alcohols _____domestic rubbish trash. _____some extent the advantages are ____described _____but additionally the amount of waste going in to landfill is reduced.

Exercise 8. Fill in the table with words and expressions from the text:

	organic materials	compounds	waste products
Example: Road vehicles normally use	-	petrol	-
The alcohols can be made from			
A useful source for producing alcohols is			
Methanol emits			
Ethanol can be produced from			

Exercise 9. Compose a story on one of the topics (up to 100 words):

“The Sources of Producing Alcohols”
“Sugar Cane and its Innovative Application”
“Pros and Cons in Greenness when Sourcing and Producing Alcohols”.

LESSON 11
RENEWABLE ENERGY AND ENVIRONMENT

Exercise 1. Read and memorize using a dictionary:

implement
stave off
emit carbon dioxide
contribute
resilient
rely on
release
embedd
encompass
sustainable
harness
capacity
deny
habitat loss
concentrating solar power
municipal solid waste

Exercise 2. Read the text:

In any discussion about climate change, renewable energy usually tops the list of changes the world can implement to stave off the worst effects of rising temperatures. That's because renewable energy sources such as solar and wind don't emit carbon dioxide and other greenhouse gases that contribute to global warming.

Clean energy has far more to recommend it than just being "green." The growing sector creates jobs, makes electric grids more resilient, expands energy access in developing countries, and helps lower energy bills. All of those factors have contributed to a renewable energy renaissance in recent years, with wind and solar setting new records for electricity generation.

For the past 150 years or so, humans have relied heavily on coal, oil, and other fossil fuels to power everything from light bulbs to cars to factories. Fossil fuels are embedded in nearly everything we do, and as a result, the greenhouse gases released from the burning of those fuels have reached historically high levels.

As greenhouse gases trap heat in the atmosphere that would otherwise escape into space, average temperatures on the surface are rising. Global warming is one symptom of climate change, the term scientists now prefer to describe the complex shifts affecting our planet’s weather and climate systems. Climate change encompasses not only rising average temperatures but also extreme weather events, shifting wildlife populations and habitats, rising seas, and a range of other impacts.

Of course, renewables—like any source of energy—have their own trade-offs and associated debates. One of them centers on the definition of renewable energy. Strictly speaking, renewable energy is just what you might think: perpetually available, or as the U.S. Energy Information Administration puts it, "virtually inexhaustible." But "renewable" doesn't necessarily mean sustainable, as opponents of corn-based ethanol or large hydropower dams often argue. It also doesn't encompass other low- or zero-emissions resources that have their own advocates, including energy efficiency and nuclear power.

Types of renewable energy sources

Hydropower: For centuries, people have harnessed the energy of river currents, using dams to control water flow. While hydropower is theoretically a clean energy source replenished by rain and snow, it also has several drawbacks.

Large dams can disrupt river ecosystems and surrounding communities, harming wildlife and displacing residents. Hydropower generation is vulnerable to silt buildup, which can compromise capacity and harm equipment. Drought can also cause problems.

Wind: Harnessing the wind as a source of energy started more than 7,000 years ago. Some people may object to how wind turbines look on the horizon and to how they sound, but wind energy, whose prices are declining, is proving too valuable a resource to deny. While most wind power comes from onshore turbines, offshore projects are appearing, too. Another problem with wind turbines is that they’re a danger for birds and bats, killing hundreds of thousands annually, not as many as from glass collisions and other threats like habitat loss and invasive species, but enough that engineers are working on solutions to make them safer for flying wildlife.

Solar: In addition to solar panels, which convert the sun's light to electricity, concentrating solar power (CSP) plants use mirrors to concentrate the sun's heat, deriving thermal energy instead.

Biomass: Biomass energy includes biofuels such as ethanol and biodiesel, wood and wood waste, biogas from landfills, and municipal solid waste. Like solar power, biomass is a flexible energy source, able to fuel vehicles, heat buildings, and produce electricity. But biomass can raise thorny issues. Critics of corn-based ethanol, for example, say it competes with the food market for corn and supports

the same harmful agricultural practices that have led to toxic algae blooms and other environmental hazards.

Geothermal: Unlike solar and wind energy, geothermal energy is always available, but it has side effects that need to be managed, such as the rotten egg smell that can accompany released hydrogen sulfide.

Exercise 3. Answer the questions:

1. Why are renewable energy sources like solar and wind considered key solutions to climate change?
2. What is the role of greenhouse gases in the Earth's atmosphere?
3. How long ago did humans begin harnessing wind as a source of energy?
4. How can the use of biomass energy be balanced with concerns about food supply and environmental impacts?
5. What is the advantage of geothermal energy?

Exercise 4. Match the left part with the right:

1) Most wind power comes from onshore turbines,	a) ecosystems and surrounding communities.
2) Renewable energy sources such as solar and wind don't	b) side effects that need to be managed
3) Dams can disrupt river	c) offshore projects are appearing, too.
4) Geothermal energy is always available, but it has	d) emit carbon dioxide and other greenhouse gases

Exercise 5. Describe *renewable energy, greenhouse gases, onshore wind energy, solar panels, biomass energy,* and *geothermal energy***, using the suggested words and expressions as in example:**

cogeneration
simultaneous, on-site, generation, electric, energy, process, steam, heat, same, plant
example:
The simultaneous on-site generation of electric energy and process steam or heat from the same plant

renewable energy
natural , replenished, rate, energy derived, consumed, from, sources, that, are, higher, they, are, .at, a, than

greenhouse gases
the, the, the, that, as, in, of, gases, the, surface, atmosphere, Earth, temperature, raise, planets, such.

onshore wind energy
turbines, wind, generated, onshore, natural, land, wind, located, movement, air, energy, power, is, the, that, is, by, on, driven, by, the, of, the.

solar panel
a, that, photovoltaic, into, sunlight, device, electricity, using, converts, by cells.

biomass energy
material, plants, renewable, animals, comes, organic that, from, and.

geothermal energy
heat, renewable, the, source, continuously, energy, because, produced, earth, is, inside.

Exercise 6. Ask questions to the given answers:

Question: _____ .
Answer: The growing sector creates jobs, makes electric grids more resilient, expands energy access in developing countries.
Question: _____ .
Answer: Engineers are working on solutions to make wind turbines safer for flying wildlife.
Question: _____ .
Answer: Biomass is a flexible energy source, able to fuel vehicles, heat buildings, and produce electricity

Exercise 7. Complete the sentences with the suggested words*:* *extracted, governments harmful, sources, form, power*

Fossil fuels, such as coal, natural gas and oil, are examples of non-renewable energy 1. _____. These sources can occur naturally, but they are finite in their amount. A disadvantage of non-renewable energy sources is that they often take hundreds of thousands of years to 2. _____, and have to be 3. _____ from the earth and burned in order to create the energy that generates electricity. They also emit 4. _____ greenhouse gases like CO2 when they're burned. There are several reasons why harnessing the 5. ____ of renewable energy sources is so important for our future. As they're in much more plentiful supply, compared to fossil fuels, 6. _____ across the world are looking to develop renewables to exclusively power their nations.

Exercise 8. Fill in the table with information from the text:

Source of power	materials	advantages	drawbacks
	-		-

Exercise 9. Compose a story on one of the topics (up to 100 words):

"The Alternative Sources of Power "
"Geothermal Energy and its Innovative Application"
"Pros and Cons in Greenness when Sourcing and Producing Energy".

LESSON 12
WIND ENERGY – PROS &CONS

Exercise 1. Read and memorize using a dictionary:

disposal	species
properly	obvious
fossil fuels	drastically
footprint	upfront costs
non-existent	issue
greenhouse gases	unpredictable
option	solely
pose	gamble

Exercise 2. Read the text:

One of the most important questions we face as a civilization is – how to make the best use of renewable energy? There are plenty of different sources of renewable energy that are at our disposal, but, unfortunately, it seems that we are not using them properly. One of those sources is, of course, wind energy. A lot of companies and corporations are trying their best to utilize the power of wind and convert it into electricity and it seems that wind energy has become a go-to choice for many companies and households. However, even though it's a renewable source of energy, the wind has its pros and cons. Here's what they are.

PROS:

Free fuel. The ultimate goal of every renewable energy source is to produce free fuel. However, most of those sources require some sort of investment even once they are manufactured and installed. Wind energy, on the other hand, does not. The only investment required is the production of wind turbines. Once the turbines are made and installed, there's no need for more investments. The turbines are using the wind to produce electricity and this is how they make free fuel.

Wind Energy Is Clean. Considering the fact that turbines don't require fossil fuels to run, they don't leave gases behind them when they work. In other words, their carbon footprint is non-existent. Sure, fossil fuels and electricity are required for the making of the turbines and their transportation, but once the turbines are made and installed, they don't produce greenhouse gases. This is one of the main reasons why wind energy is considered to be one of the cleanest sources of energy today.

Wind Turbines Don't Disrupt the Farmland Operations. Why is this important? Well, the answer is pretty simple. In order to utilize the power of wind energy, the government has to find a big piece of land where they will put the turbines. The only option is to put the turbines on the farms.

CONS:

It Poses a Danger to Some Animals. However, wind turbines may pose a threat to some animals. Logically, birds and bats are the species that are in the most obvious danger by the turbines. If the turbines are not set properly, the fans might stand in the migration way of some birds. If this happens, thousands of birds might be killed. Plenty of farmers point out this as their main concern when it comes to the installation of wind turbines.

Upfront Costs. This reduces the costs drastically and that's why governments are interested in this energy source. On paper, this is a no-brainer. However, in order to install wind turbines, the government has to invest a lot of money. This is why one of the main disadvantages of wind energy is the upfront costs.

Wind Energy Is Unpredictable. The noise pollution and upfront costs are two issues the government and manufacturers have to consider before installing the turbines, but there's one more thing that's, perhaps, more important. Wind energy can be rather unpredictable. Why is that? Well, the answer is quite simple. Considering the fact that wind turbines don't require fuel to work, they rely solely on the wind. As you probably know, wind can be unpredictable. During a single day, there can be windy periods and periods when there's no wind. This means that the daily output of electricity is rather unpredictable. Manufacturers and electricity companies can't afford to guess how much electricity the turbines will produce. It's too much of a gamble for them. This is why this unpredictability is considered to be one of the main disadvantages of wind energy.

Exercise 3. Answer the questions:

1) Why wind energy is considered a clean source of energy?
2) What makes wind turbines a favorable option for farmland operations?
3) What is one major risk that wind turbines pose to wildlife?
4) Why might the government still be interested in investing in wind energy despite its cons?

Exercise 4. Match the left part with the right:

1)The ultimate goal of every renewable energy source	a) might be killed.
2) In order to utilize the power of wind energy,	b) how much electricity the turbines will produce.
3)If this happens, thousands of birds	c) is to produce free fuel.
4)Electricity companies can't afford to guess	d) the government has to find a big piece of land

Exercise 5. Describe *installation, renewable energy, greenhouse gases, turbine, advantage, to invest* using the suggested words and expressions as in example:

Installation
A machine, equipment, position, ready to use
example:
The act of putting a machine, or a piece of equipment into position and making it ready to use

renewable energy
naturally replenished, comes from , unlimited, the sun, wind, resources, such as, tides.

greenhouse gases
emitted from, category of gases, absorb, remain in Earth's atmosphere, heat energy, the planet's surface, for a long time

turbine
various devices, in a stream of fluid, into mechanical, convert the energy, .

advantage
condition, greater chance, success

to invest
make a profit, to put money into, shares in a company, etc., get an advantage.

Exercise 6. Ask questions to the given answers:

Question: _____ .
Answer: Most of those sources require some sort of investment even once they are manufactured and installed.
Question: _____ .
Answer: A lot of companies and corporations are trying their best to utilize the power of wind and convert it into electricity.
Question: _____ .
Answer: Wind energy can be rather unpredictable.

Exercise 7. Complete the sentences with the suggested words: *installed, require, wind, every, electricity*

The ultimate goal of ….. renewable energy source is to produce free fuel. However, most of those sources …… some sort of investment even once they are manufactured and …… . Wind energy, on the other hand, does not. The only investment required is the production of …… turbines. Once the turbines are made and installed, there's no need for more investments. The turbines are using the wind to produce …….. and this is how they make free fuel.

Exercise 8. Fill in the table with words and expressions from the text:

	Renewable sources	Petrol	Wind
Example: Road vehicles normally use	-	+	-
Most machines are in dependence on ….			
These types of energy can be almost free			
These turbines rely solely on the….			

Exercise 9. Compose a story on one of the topics (up to 100 words):

"Wind turbines – advantages and disadvantages"
"Wind power and our environment"
"The prices of wind turbines – cheap or expensive?".

LESSON 13
HYDROGEN ENERGY

Exercise 1. Read and memorize using a dictionary:

energy carriers
substance
comparable volume
spacecraft
salt cavern
depleted oil
aquifer
pipeline
liquefaction
cyrogenic
emissions
accessible

Exercise 2. Read the text:

Energy carriers transport energy in a usable form from one place to another. Hydrogen, like electricity, is an energy carrier that must be obtained from another substance. Hydrogen can be separated from a variety of sources including water, fossil fuels, or biomass and used as a source of energy or fuel. Hydrogen—in gaseous or liquid form—has the highest energy content of any common fuel by weight (about three times more than gasoline) but has the lowest energy content by volume. Even liquid hydrogen has only about one-fourth of the energy content as a comparable volume of gasoline.

It takes more energy to produce hydrogen (by separating it from other elements in molecules) than hydrogen provides when it is converted to useful energy. However, hydrogen is useful as an energy source/fuel because it has a high energy content per unit of weight, which is why it is used as a rocket fuel and in fuel cells to produce electricity on some spacecraft. Hydrogen is not widely used as a fuel now, but it has the potential for greater use in the future.

Hydrogen storage is an important technology to enable hydrogen use across the U.S. economy. Hydrogen may be stored as a:

Gas–Hydrogen can be stored as a gas in large volumes in natural geological formations–salt caverns, lined hard rock caverns, depleted oil and natural gas fields, and aquifers. Gaseous hydrogen may also be stored in relatively smaller volumes in pressurized, stationary or portable tanks, and in dedicated hydrogen gas pipeline infrastructure. Gaseous storage is currently the most common and the most likely option for expanding hydrogen storage for most uses of hydrogen as an energy source.

Liquid–Hydrogen can be liquefied by cooling it to below −423F (−253C). The liquefied hydrogen can be stored in super-cooled (cryogenic) tanks for transportation applications in fuel cell vehicles or directly as fuel in truck, rail, marine, and rocket engines. NASA has the two largest liquid hydrogen storage tanks in the world. Hydrogen liquefaction and cyrogenic liquid storage is an energy intensive and expensive process.

Hydrogen could help to reduce carbon dioxide emissions from electricity generation by storing energy produced with renewable energy for use over days or weeks. Hydrogen could be produced with renewable resources when renewable energy production is high and could be stored to generate electricity when renewable resources are limited and electricity demand is high. One example is the Advanced Clean Energy Storage project in Utah, which plans to store large volumes of gaseous hydrogen produced from renewable resources for long-term seasonal energy storage.

The high cost of fuel cells and the small number of hydrogen fueling stations have limited the number of hydrogen-fueled vehicles in use today. Production of hydrogen-fueled vehicles is limited because people won't buy those vehicles if hydrogen refueling stations are not easily accessible, and companies won't build refueling stations if they don't have customers with hydrogen-fueled vehicles. The United States has about 56 hydrogen-vehicle-fueling stations, all of which are in California.

Exercise 3. Answer the questions:

1) What is an energy carrier, and how does hydrogen function as one?
2) Why is hydrogen considered a valuable fuel despite requiring more energy for production than it provides when converted to usable energy?
3) What are the common methods for hydrogen storage mentioned in the text?
4) How can hydrogen help reduce carbon dioxide emissions from electricity generation?

Exercise 4. Match the left part with the right:

1. Hydrogen, like electricity, is an energy carrier that	a) enable hydrogen use across the U.S. economy.
2. Hydrogen—in gaseous or liquid form—has the	b) must be obtained from another substance.
3. Hydrogen storage is an important technology to	c) have limited the number of hydrogen-fueled vehicles in use today.
4. The high cost of fuel cells and the small number of hydrogen fueling stations	d) highest energy content of any common fuel by weight

Exercise 5. Describe *energy carrier, liquid hydrogen, fuel, spacecraft, pipeline infrastructure, hydrogen refueling station* using the suggested words and expressions as in example:

Energy carrier

Substance, system that stores, transports, and delivers, in a form, energy, to convert, other forms of energy

example

An energy carrier is defined as a substance or system that stores, transports, and delivers energy in a form that can be readily converted into other forms of energy or used to perform work.

liquid hydrogen

hydrogen gas, cooled, extremely low temperature, turning, a liquid state.

fuel

material, stores potential energy, can be released, to perform work, by combustion, chemical reaction.

spacecraft

vehicle or device, designed, for travel, in outer space. For various purposes, such as, exploration, research, communication, transportation of cargo, crew.

pipeline infrastructure

a network, pipelines, to transport fluids, gases, liquids, slurries, long distances.

hydrogen refueling station

a specialized facility, hydrogen, fuel, stored, dispensed, hydrogen-powered, vehicles.

Exercise 6. Ask questions to the given answers:

1)Question: _____?

Answer: Hydrogen is useful as an energy source/fuel because it has a high energy content per unit of weight.

2)Question:_____?

Answer: Hydrogen can be stored as a gas or as liquid.

3) Question:_____?

Answer: Production of hydrogen-fueled vehicles is limited because people won't buy those vehicles if hydrogen refueling stations are not easily accessible.

Exercise 7. Complete the sentences with the suggested words: *number, cost, easily, with, vehicles*

The high ….. of fuel cells and the small number of hydrogen fueling stations have limited the ….. of hydrogen-fueled vehicles in use today. Production of hydrogen-fueled ….. is limited because people won't buy those vehicles if hydrogen refueling stations are not ….. accessible, and companies won't build refueling stations if they don't have customers ….. hydrogen-fueled vehicles.

Exercise 8. Fill in the table with words and expressions from the text:

Mn2	degrees	forms of fuel	Devices/stations
Example: The Middelgrunden wind farm includes	-	-	20 wind turbines.
Hydrogen can be liquefied by cooling it to below			
Hydrogen has the highest energy content of any common fuel by weight			
The United States has about 56 hydrogen-vehicle-fueling stations, all of which are in California.			

Exercise 9. Compose a story on one of the topics (up to 100 words):

"What is Hydrogen Power?"
"Hydrogen Power – Advantages and Disadvantages"

LESSON 14
ENERGY AUDIT

Exercise 1. Read and memorize using a dictionary:

audit process
facility
utility bill
depend on
in terms of
substantial
tape measure
excess
removal
interchangeable probe
radiation shielded probe
ladder

Exercise 2. Read the text:

The audit process starts by collecting information about a facility's operation and about its past record of utility bills. This data is then analyzed to get a picture of how the facility uses (and possibly wastes) energy, as well as to help the auditor learn what areas to examine to reduce energy costs. Specific changes (called Energy Conservation Opportunities (ECOs) are identified and evaluated to determine their benefits and their cost-effectiveness. These Energy Conservation Opportunities (ECOs) are assessed in terms of their costs and benefits, and an economic comparison is made to rank the various ECOs. Finally, an Action Plan is created where certain Energy Conservation Opportunities (ECOs) are selected for implementation, and the actual process of saving energy and saving money begins.

The Auditor's Toolbox

To obtain the best information for a successful energy cost control program, the auditor must make some measurements during the audit visit. The amount of equipment needed depends on the type of energy consuming equipment used at the facility, and on the range of potential Energy Conservation Opportunities (ECOs) that might be considered. For example, if waste heat recovery is being considered, then the auditor must take substantial temperature measurement data from potential heat sources. Tools that are commonly needed for energy audits are listed below:

Tape Measures

The most basic measuring device needed is the tape measure. A 25-foot tape measure l" wide and a 100- foot tape measure are used to check the dimensions of walls, ceilings, windows and distances between pieces of equipment for purposes such as determining the length of a pipe for transferring waste heat from one piece of equipment to the other.

Lightmeter

One simple and useful instrument is the lightmeter which is used to measure illumination levels in facilities. A lightmeter that reads in foot-candles allows direct analysis of lighting systems and comparison with recommended light levels specified by the Illuminating Engineering Society. A small lightmeter that is portable and can fit into a pocket is the most useful. Many areas in buildings and plants are still significantly overlighted, and measuring this excess illumination then allows the auditor to recommend a reduction in lighting levels through lamp removal programs or by replacing inefficient lamps with high efficiency lamps that may not supply the same amount of illumination as the old inefficient lamps.

Thermometers

Several thermometers are generally needed to measure temperatures in offices and other worker areas, and to measure the temperature of operating equipment. Knowing process temperatures allows the auditor to determine process equipment efficiencies, and also to identify waste heat sources for potential heat recovery programs. Inexpensive electronic thermometers with interchangeable probes are now available to measure temperatures in both these areas. Some common types include an immersion probe, a surface temperature probe, and a radiation shielded probe for measuring true air temperature. Other types of infra-red thermometers and thermographic equipment are also available. An infra-red “gun” is valuable for measuring temperatures of steam lines that are not readily reached without a ladder.

Exercise 3. Answer the questions:

1) What is the initial step in the audit process for a facility's energy assessment?
2) Why is a tape measure important for energy audits, and what measurements does it help with?
3) How does a lightmeter assist auditors during an energy audit, and what issues does it help identify?
4) Why is an infra-red thermometer valuable in the audit process, and when might it be used?

Exercise 4. Match the left part with the right:

1. To obtain the best information for a successful energy cost control program,	a) can fit into a pocket is the most useful.

2. A small lightmeter that is portable and	b) a radiation shielded probe for measuring true air temperature.
3. Knowing process temperatures allows	c) the auditor must make some measurements during the audit visit.
4. Some common types include an immersion probe, a surface temperature probe, and	d) the auditor to determine process equipment efficiencies.

Exercise 5. Describe *audit, toolbox, tape measure, lightmeter, thermometer, equipment* using the suggested words and expressions as in example:

Audit
systematic examination, evaluation of records, processes, systems, to ensure accuracy, compliance, efficiency.
Example:
An **audit** is a systematic examination and evaluation of records, processes, or systems to ensure accuracy, compliance, and efficiency.

toolbox
a container, storage unit, to hold, to organize, tools, equipment, portable, stationary

tape measure
a flexible measuring tool, determine length, width, distance, long, narrow, strip of material, metal or plastic, measurement units

lightmeter
Instrument, use, to measure, intensity of light, provide, readings in units, lux or foot-candles

thermometer
Instrument, use, measure temperature, various purposes, monitoring, air temperature, body temperature, temperature of liquids, surfaces.

equipment
set of tools, machinery, devices, need to perform, a specific task, activity, include, anything from simple hand tools to complex machines

Exercise 6. Ask questions to the given answers:

1)Question: _____?
Answer: The audit process starts by collecting information about a facility's operation and about its past record of utility bills.
2)Question: _____?
Answer: Many areas in buildings and plants are still significantly overlighted, and measuring this excess illumination then allows the auditor to recommend a reduction in lighting levels.
3)Question: _____?
Answer: Several thermometers are generally needed to measure temperatures in offices and other worker areas, and to measure the temperature of operating equipment.

Exercise 7. Complete the sentences with the suggested words: *which, fit, still, levels, with*
One simple and useful instrument is the lightmeter ….. is used to measure illumination levels in facilities. A small lightmeter that is portable and can ….. into a pocket is the most useful. Many areas in buildings and plants are ….. significantly overlighted, and measuring this excess illumination then allows the auditor to recommend a reduction in lighting ….. through lamp removal programs or by replacing inefficient lamps ….. high efficiency lamps that may not supply the same amount of illumination as the old inefficient lamps.

Exercise 8. Fill in the table with words and expressions from the text:

	tools	physical phenomena	results
Example: The source of geothermal energy is	-	the earth's internal heat.	
One simple and useful instrument is the lightmeter which is used to measure illumination levels in facilities.			
Knowing process temperatures allows the auditor to determine process equipment efficiencies,			
Some common types include an immersion probe, a surface temperature probe, and a radiation shielded probe for measuring true air temperature.			

Exercise 9. Compose a story on one of the topics (up to 100 words):

"Do we need energy audit and why?"
"Necessary tools in energy audit"

LESSON 15
EFFECTIVE ENERGY MANAGEMENT

Exercise 1. Read and memorize using a dictionary:

preliminary	consumption
decade	load shifting
extract	disruption
viable way	edge
instigate	contingency
implement	occurrence
upward trend	emerge

Exercise 2. Read the text:

Some years ago, a newspaper headline stated, "Lower energy use leaves experts pleased but puzzled." The article went on to state "Although the data are preliminary, experts are baffled that the country appears to have broken the decades-old link between economic growth and energy consumption." For those involved in energy management, this comes as no surprise. We have seen companies becoming more efficient in their use of energy, and that's showing in the data. Those that have extracted all possible savings from downsizing are now looking for other ways to become more competitive. Better management of energy is a viable way, so there is an upward trend in the number of companies that are establishing an energy management program. Management is now beginning to realize they are leaving a lot of money on the table when they do not instigate a good energy management plan.

With the new technologies and alternative energy sources now available, the country could possibly reduce its energy consumption by 50%—if there were no barriers to the implementation. But of course, there are barriers, mostly economic. Therefore, we might conclude that managing energy is not a just technical challenge, but one of how to best implement those technical changes within economic limits, and with a minimum of disruption.

Unlike other management fads that have come and gone, such as value analysis and quality circles, the need to manage energy will be permanent within our society.

There are several reasons for this:

• There is a direct economic return. Most opportunities, found in an energy survey, have less than a two year payback. Some are immediate, such as load shifting or going to a new electric rate schedule. Most manufacturing companies are looking for a competitive edge. A reduction in energy costs to manufacture the product can be immediate and permanent. In addition, products that use energy, such as motor driven machinery, are being evaluated to make them more energy efficient, and therefore more marketable. Many foreign countries, where energy is more critical, now want to know the maximum power required to operate a piece of equipment.

• Energy technology is changing so rapidly that state-of-the-art techniques have a half life of ten years at the most. Someone in the organization must be in a position to constantly evaluate and update this technology.

• Energy security is a part of energy management. Without a contingency plan for temporary shortages or outages, and a strategic plan for long range plans, organizations run a risk of major problems without immediate solutions.

• Future price shocks will occur. When world energy markets swing wildly with only a five percent decrease in supply, as they did in 1980s, it is reasonable to expect that such occurrences will happen again.

Those people then who choose—or in many cases are drafted—to manage energy will do well to recognize this continuing need, and exert the extra effort to become skilled in this emerging and dynamic profession.

Exercise 3. Answer the questions:
1) What is driving more companies to establish energy management programs?
2) Why is energy management considered more than just a technical challenge?
3) What are some immediate economic returns from implementing an energy management plan?
4) Why is it important for organizations to constantly evaluate and update their energy technology?

Exercise 4. Match the left part with the right:

1.Management is now beginning to realize they are leaving a lot of money on the table	a) one of how to best implement those technical changes within economic limits, and with a minimum of disruption.
2. We might conclude that managing energy is not a just technical challenge, but	b) now want to know the maximum power required to operate a piece of equipment.
3. Many foreign countries, where energy is more critical,	c) a strategic plan for long range plans, organizations run a risk of major problems without immediate solutions.
4. Without a contingency plan for temporary shortages or outages, and	d)when they do not instigate a good energy management plan.

Exercise 5. Describe *efficient use, expert, consumption, permanent, half life* using the suggested words and expressions as in example:

Efficient use
Practice, utilizing resources, energy, systems, maximize output, productivity, minimizing waste, unnecessary consumption.
Example:
Efficient use refers to the practice of utilizing resources, energy, or systems in a way that maximizes output or productivity while minimizing waste and unnecessary consumption.

expert
a person, high level, knowledge, skill, relate to, particular subject, activity

consumption
the amount, substance, to be used, to be eaten

permanent
something, last, for a long time, sometimes, forever

half life
the length, time, needed for, radioactivity, radioactive substance, to be reduced, by half

Exercise 6. Ask questions to the given answers:
4) Question: _____?
Answer: Better management of energy is a viable way
5) Question: _____ ?
Answer: Most opportunities, found in an energy survey, have less than a two year payback.
6) Question: _____?
Answer: Many foreign countries, where energy is more critical, now want to know the maximum power required to operate a piece of equipment.

Exercise 7. Complete the sentences with the suggested words: *technical, changes, available, barriers, energy,*
With the new technologies and alternative energy sources now….. , the country could possibly reduce its ….. consumption by 50%—if there were no barriers to the implementation. But of course, there are….. , mostly economic. Therefore, we might conclude that managing energy is not a just ….. challenge, but one of how to best implement those technical ….. within economic limits, and with a minimum of disruption.

Exercise 8. Fill in the table with words and expressions from the text:

	data	technologies	consumption
Example: Talking about biofuels we mean	-	-	biodisel, methanol and ethanol.
We have seen companies becoming more efficient in their use of energy			
…. now available, the country could possibly reduce its energy consumption by 50%			
Energy technology is changing so rapidly that state-of-the-art techniques have a half life of ten years at the most.			

Exercise 9. Compose a story on one of the topics (up to 100 words):

“Energy management in your country”
“Quality circles in energy management”

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