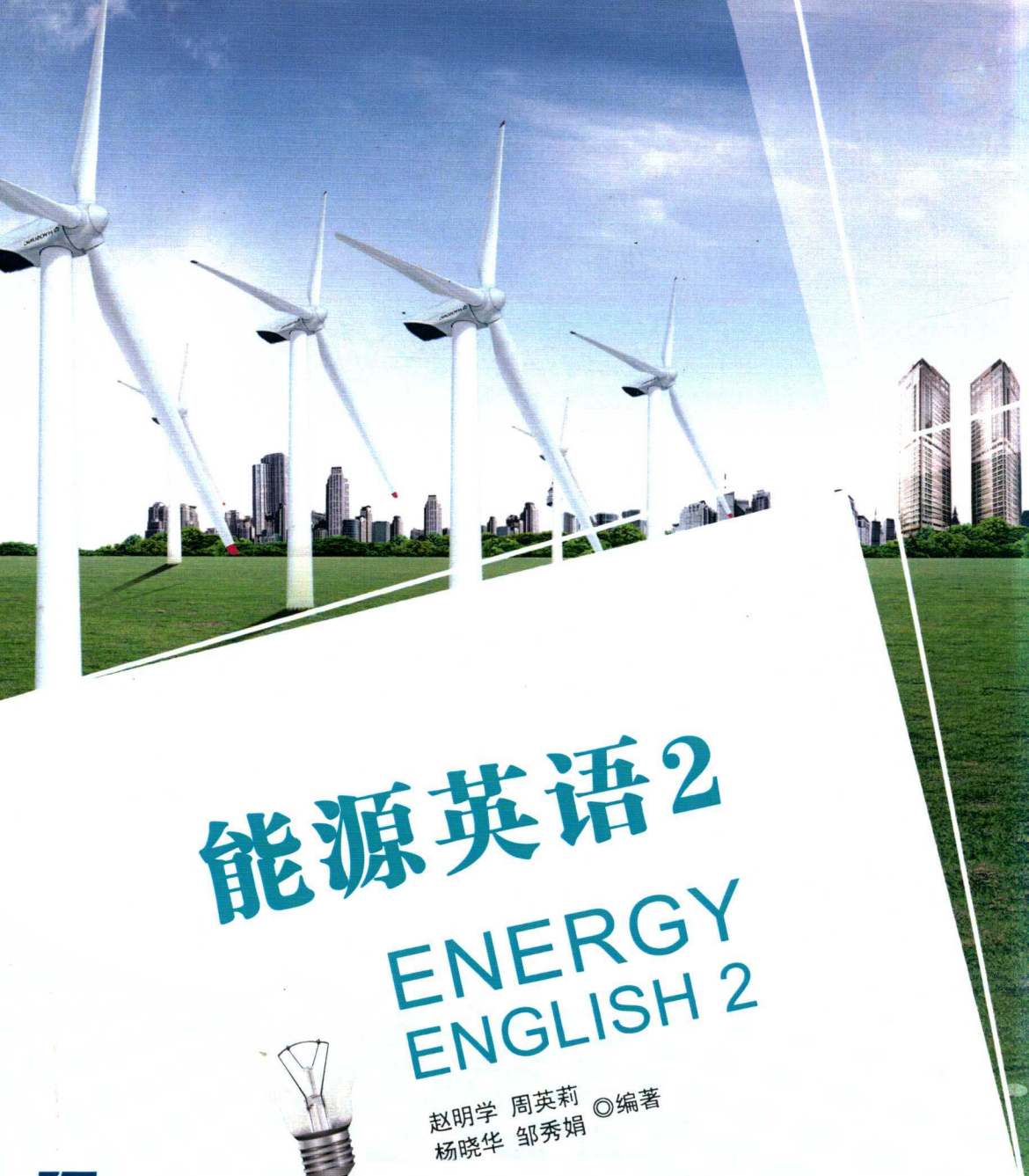

能源英语2

ENERGY ENGLISH 2

赵明学 周英莉
杨晓华 邹秀娟 ◎编著

全国百佳图书出版单位
知识产权出版社

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内容提要

《能源英语 2》在《能源英语 1》的基础上阐明了能源与安全、经济、科技、环境及政策的关系，并在此框架下对新旧能源展开了对比。此外，教师通过此书可帮助学生选定能源领域的专业研究课题，对学生开展学术英语综合运用能力的训练，提高学生在能源领域的专业知识水平和培养学生能源领域的学术英语运用能力。其具体包括：听懂相关专业课程和专业讲座的能力，搜索、阅读和评价专业文献的能力，撰写文献摘要、述评和专业小论文的能力，口头陈述和演示科研成果的能力，参加学术讨论的能力。该教材适用于已具备一定听、说、读、写、译能力的英语专业高年级学生和非英语专业研究生。

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1 Energy Reserve and Security

1.1 Are Conventional Energy Sources Depleting

Conventional energy sources are normally regarded as reliable, easily extractable and accessible; while they, except hydro, are also characterized by being non-renewable. Commentators are either pessimistic and concerned with the sustainability of those energy sources or optimistic and confident of technological improvement. Their viewpoints are grouped as Voice A and Voice B standing for different attitudes towards the issue.

Coal

Voice A

Many experts claim that conventional energy sources are exhaustible and no longer reliable, and they will not run out suddenly but diminish at a speed during a period ranging from decades to one or two hundred years. Hubbert's peak theory[①] predicted that coal and natural gas production would follow a logistic curve similar to that of oil due to their finite reserves. Virtually after centuries of mineral exploration, coal reservoirs in most countries are mature. Considering the growing gap between energy supply and energy demand, these sources will deplete at a faster rate, which means the increasing imbalance between coal production and consumption due to a declining supply of accessible coal.

---

① Hubbert's peak theory n. phr. 哈伯特峰值理论,源于1949年美国著名石油地质学家哈伯特发现的矿物资源"钟形曲线"规律。

Voice B

Coal reserves are available in almost every country worldwide, with recoverable reserves① in around 70 countries. Improvements of technologies promise the access to more coal resources.

First, new reserves are discovered through ongoing and improved exploration activities. Second, advances in mining techniques will allow previously inaccessible reserves available. Data from BP World Energy Statistics 2013② shows that in 2012, global coal production was 7.86 billion tons, a 2% increase from one year earlier. Ten countries' production exceeded a hundred million tons in 2012. Most of the major coal producers except China and the U. S. showed growth in different degrees. (Table 1.1).[1] Despite of its decrease in coal production in 2012, China's output in 2013 was 3.68 billion tons, increasing by 0.8% year on year[2]. China's coal resources in the shallow level are depleting, but a large amount within the depth of 2000 meters③ are still not mined.

Table 1.1 World's Coal Production 2012[1]

Rank	Country	Amount of coal production (Mt)	Increasing ratio of coal production (%)
1	China	3,650	-2
2	U. S.	922	-7.5
3	India	606	5.8
4	Australia	431	4.2
5	Indonesia	386	9
6	Russia	355	6.1
7	South Africa	260	3.1
8	Germany	196	2.0
9	Poland	144	3.6
10	Kazakhstan	116	4.2

① recoverable reserves n. phr. 可采储量

② BP World Energy Statistics n. phr.《BP 世界能源统计 2013》

③ within the depth of 2000 meters prep. phr. 地下 2000 米以内

Petroleum

Voice A

Petroleum is the most essential resource with the largest share in global energy consumption. However, its sustainability is challenged since 1956, when King Hubbert put forward "Peak Oil Theory". His "Peak Oil Theory" is based on the concept that the amount of petroleum under the ground in any region is finite, therefore, for any given geographical area, from an individual oil-producing region to the planet as a whole, the rate of petroleum production tends to follow a bell-shaped curve—the rate of extraction which initially increases quickly must reach a maximum, and after 40 years when half of the petroleum has been extracted, the rate will decline and a period of petroleum depletion will follow. [1] In other words, when the maximum rate of petroleum extraction has been reached, subsequent methods of extraction cannot increase the rate further.

He predicted that the petroleum production in American 48 states would reach peak in 1970s and petroleum production would fall after 40 years of extraction. This prediction has been proved. Since 1970s the production of petroleum in the contiguous 48 states, except Alaska and Hawaii, of United States have began to decline. [3] Despite technology leap in oil exploration and extraction, and derrick quantity in United States is 4 times that of 1970s, its crude oil production is still only half of 1970.

Conventional petroleum producing regions have been extracted for more than 140 years and become less productive. The International Energy Agency (IEA) reported in its 2008 Word Energy Outlook that the "rate of decline in existing oil fields goes from 3.7% to 6.7% per year" [4]. In Europe where industrial revolution originated, many of the oil fields have already peaked and there is slight chance, if possible, to exploit new petroleum fields. The UK oil supply has been declined since 1999. Norway followed in 2001. Some experts agree that if the world has not already reached peak petroleum production, then it will do so within the next 20 years.

Increasing levels of activity and technological intervention are indispensible to maintain or slow declines in output. Non-conventional petroleum sources inclu-

ding tar sands①, deep water oil and shale oil require large amount of energy for extraction. Consequently, less petroleum production will be realized at higher cost. The world's current economic growth is powered by the cheap, easily extractable, good quality petroleum. Since all economic sectors rely heavily on petroleum, peak oil could lead to a "partial or complete failure of markets" or, simply an orderly transition to 100% renewable energy, within as short as a decade[5]. Biofuels (primarily ethanol, but also biodiesel) will continue to supplement petroleum. However their output levels are too low to displace local oil production. How far can we go without this gift from nature?

Voice B

The opposite voice is that there is a great potential in oil production. There are two sources for this increase. First, the growth in oil production capacity would come from OPEC and non-OPEC countries. The largest non-OPEC growth would come expectedly from Canada, Kazakhstan, Brazil, Azerbaijan, Angola and Russia. Growth would also occur in OPEC countries, such as Saudi Arabia, Nigeria, Algeria and Libya. The oil industry is governed by a "law of long-lead times" and much of the new capacity would become available. Second, a common pattern in the shortage periods is to underestimate the impact of technology. As skills improved, output from many producing regions would be much greater than anticipated. In fact, world's remaining proved petroleum reserves keep increasing thanks to the updated technology, as it is revealed by the statistics in Figure 1.1.

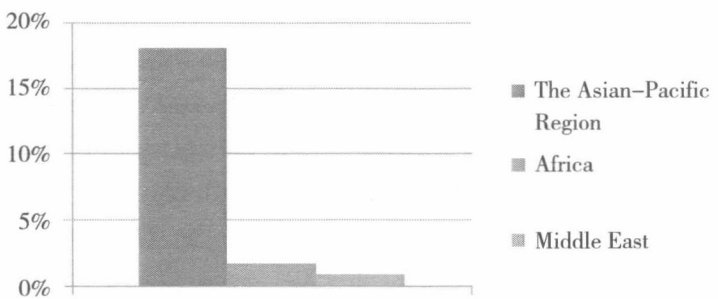

Fig. 1.1 Increases in Remaining Proved Petroleum Reserves[6]

① tar sand n. phr. 油砂,又称焦油砂、重油砂或沥青砂,外观如黑色糖蜜,可用以提炼重油和沥青。

Unconventional oil resources (Canadian oil sands, deep water oil and shale oil) are another supply to current oil need. The unconventional will cease being frontier and instead become conventional. 85% of unconventional oil reserves are concentrated in the areas of Ashabasca①, Cold Lake② and Peace River③ in Alberta④, Canada. Canada's proven oil sand reserves in 2011 were 170 billion barrels[7], only behind the reserves of Saudi Arabia. China ranks 5th in oil sand reserves. There are many areas to be explored, such as deep strata⑤ and offshore deep water parts, which imply more oil and gas reservoirs.

Natural Gas

Voice A

Reserves of natural gas are finite because its formation goes through the same process as petroleum. According to BP Statistics Review of World Energy 2014, the life duration of proved gas reserves is around 55.1 years.[8] Natural gas is labeled clean energy and little environmentally destructive. If it substitutes coal for electricity or petroleum for transport, the rate of supply will peak and decline much sooner than previously estimated. Recently, most natural gas wells in the U.S. that are easily extractable are depleted. 70% of its gas is extracted in the wells 1500 meters deep. Besides, supply of natural gas is possibly suspended due to hurricane. The supply interruption caused by Katrina, the hurricane happened in Mexico Bay in 2005, is a typical case[9].

Natural gas hydrate⑥(in short form, gas hydrate), also called flammable ice or clathrate⑦, seems to be an appealing resource. It is almost pure methane mixed with water. Natural gas hydrate exists in vast quantities around the world. However, most gas hydrate is under the sea and exists in the form of ice at low

① Ashabasca n. 阿沙巴斯克
② Cold Lake n. phr. 冷湖
③ Peace River n. phr. 和平河
④ Alberta n. 加拿大艾伯塔省
⑤ strata n. 地层
⑥ natural gas hydrate n. phr. 天然气水合物
⑦ clathrate n. 笼形包合物

temperature and under high pressure. Maintaining its ice form in delivery is a big challenge and so far it isn't commercially producible.

Voice B

Growth of proved recoverable reserves is found in natural gas sector. Since 1980, proved world's natural gas reserves have grown at an average ratio of 3.4% (compared with 2.4% for oil), due to an impressive string of gas exploration successes and better assessments of existing fields. Statistics from American Oil& Gas Journal showed that global remaining recoverable natural gas reserves in 2013 were $198.9 \times 10^{12} m^3$, an increase of 1.5% from 2012. The increase in Africa in 2013 was 17.7%.[10] The growth of global reserves is shown in Table 1.2.

Table 1.2 World's Remaining Proven Natural Gas Reserves 1990—2010 (Unit: $10^8 m^3$)[10]

Country/Region	2012	2013	Creasing ratio (%)
Asia-Pacific region	147 678.6	152 702.0	3.4
Western Europe	38 178.2	37 223.2	-2.5
Eastern Europe and CIS①	619 850.6	619 851.5	0.0
Middle East	799 684.3	801 028.1	0.2
Africa	145 797.9	171 593.7	17.7
Western Hemisphere	199 122.5	207 048.1	4.0
OPEC	951 371.6	951 378.7	0.0
World	**1 950 028.8**	**1 989 163.4**	**2.0**

Improvement of technology makes natural gas hydrate another source of natural gas supply. One cubic meter of natural gas hydrate decomposes into 164 cubic meters of natural gas and 0.8 cubic meter of fresh water at normal pressure and temperature②(NPT). Gas hydrate reserves are also found in China. The gas hydrate laboratory has been established in China.

Significant potential shale gas reserves are discovered in China (20% of the

① CIS n. abbr. Commonwealth of Independent States,独联体,独立国家联合体的简称

② normal pressure and temperature n. phr. 常温常压

world total), America (13%), Argentina, Mexico and South Africa[11]. Shale gas may play a supporting role in gas supply.

Hydro Energy

Voice A

Approximately 19% of the world's electricity is supplied by hydro energy. Currently hydropower has no sufficient room to expand by the year of 2020 for its mature development. North America and Europe use over 80% of their hydropower potential. Two-thirds of the global hydro energy resources remain unexploited. If all the remaining economically exploitable capacity in the world was utilized, the existing hydropower capacity would be tripled. But compared with the world's energy demand, hydro energy resources are very limited.

Voice B

Substantial small hydropower facilities can be installed to meet residential electricity need. For instance, there are rich hydro reserves in the provinces of Yunnan and Sichuan, China. China's second-largest hydropower station—Xiluodu Hydropower Station①, became operational in 2013. The No. 13 power generating unit with a capacity of 770,000kW at Xiluodu Hydropower Station started providing electricity to China Southern Power Grid②. 18 power generating units are projected to be completed in 2015. With a total generating capacity of 13.86 gigawatts, the station is the world's third-largest after China Yangtze Three Gorges Project (TGP) and Itaipu Hydropower Project③ in Brazil.

Nuclear Energy

Voice A

Nuclear energy is non-renewable considering that currently most nuclear fis-

---

① Xiluodu Hydropower Station n. phr. 溪洛渡水电站,中国"西电东送"重要工程,大坝高285.5米,为世界泄洪量最大的大坝;总装机容量1386万千瓦,年均发电517.2亿千瓦时,是中国第二大水电站。

② China Southern Power Grid n. phr. 中国南方电网有限责任公司

③ Itaipu Hydropower Project n. phr. 伊泰普水电站,位于巴西和巴拉圭交界的巴拉那河上,大坝长7744米,高196米,水库蓄水深度250米,总装机容量1400万千瓦。

sion reactors for commercial electricity generation are uranium-fueled. The nuclear fuels for fission, mainly uranium, are scattered widely in the world but in an extremely low density except in several places with useful concentration. If we intended to substitute nuclear power for all fossil fuel-generated electricity, there would only be enough economically viable uranium to fuel the reactors for three or four years. Actually, the concept of peak nuclear has already been put forward. U-235 can also be extracted from sea water, but the cost for this method is extremely high. Nuclear fuels, such as deuterium①, for fusion are ample in heavy water in the sea, but this reaction for commercial operation is still a fantasy.

Voice B

The spent fuel from nuclear fission reactors still has 95% of its potential energy and can be stored securely for its productive use in the future.

1.2 Are New Energy Sources Sufficient

Advocates are optimistic about the renewability and abundance of new energy sources. Those energy sources are the chances to get sufficient energy supply for poor countries, especially those lacking fossil fuels and nuclear fuel. They can be combined to suit to individual country's energy supply. Each time when there is energy supply suspension and interruption, new energy sources show their advantage of infiniteness and get governments' concern. Nonetheless, opponents doubt the large-scale commercial operation of those new energy sources due to their unstable distribution and low energy density.

Solar Energy

Voice A

Solar energy is a substantial permanent energy source. Although only a tiny fraction of solar energy can be captured by earth, the total annual solar radiation falling on the earth is more than 7,500 times of the world's total annual primary energy consumption. That is to say, more energy from the sun falls on earth in

① deuterium n. 氘,即重氢, 氢的同位素

one hour than is used by human beings in one year. The total solar energy absorbed by the earth's atmosphere, oceans and land masses is approximately 3,850,000 exajoules①(EJ) per year. The amount of solar energy reaching the surface of the planet is so vast that in one year it is about twice as much as will ever be obtained from all of earth's non-renewable resources of coal, oil, natural gas, and mined uranium combined. The theoretical solar energy reserves in China approximately amount to 1.7 trillion tons of standard coal each year[12], with a great potential in electricity generation.

Voice B

Solar energy harness confronts three adverse factors.

(1) Solar energy has low density. Solar constant② decides that the energy input any solar device receives is less than 1,368W/m^2. Actually the largest input is about 1,000W/m^2 due to clouds, steam, forest fire smog, volcano ash, etc.

(2) Solar energy is unstable. It changes with season, time and weather. Photovoltaic power generation is reduced by 10 times if clouds cover the sun.

(3) Solar energy is affected by local geological factors. Some regions that are vertical to solar rays receive substantial solar radiation while others that are parallel to the rays capture almost no radiation.

Wind Energy

Voice A

Wind energy is free and inexhaustible and has been harnessed for thousands of years. Unlike fossil fuels such as coal and oil, which exist in a finite supply and must be extracted from the earth at great environmental cost, wind turbines harness a boundless supply of kinetic energy in the form of wind.

The modern equivalents of windmills—wind turbines—can use the wind's energy to generate electricity. Global wind energy is about 2.74×10^9 MW, of

① exajoule n. 艾焦耳,1EJ 相当于 10 的 18 次方焦耳

② solar constant n. phr. 太阳常数,理论上大气上方与太阳光垂直放置的平板每平方米接收的太阳电磁场能量的功率约为 1368 瓦,这个数字为太阳常数。

which 2×10^7 MW is exploitable, almost 10 times more than the total exploitable capacity of hydro energy. The exploitable reserves of land wind energy in China are estimated to be 2.53×10^8 kW. [13] By the end of 2013, the world's total installed capacity of wind power is 318MW, and China's total installed capacity of wind power is 91.4MW, just a tiny fraction of its total wind resource. [14] The figures reveal a great developing and exploiting potential.

Voice B

Wind energy harness encounters two unfavorable factors.

(1) The instability of wind energy greatly impacts wind power. Violent wind, such as typhoon, tornado can not be harnessed. The same goes to soft wind, such as breeze. There will be no power if wind stops.

(2) Places with abundant wind energy, such as distant ocean and passes① are usually remote from energy demanding areas and cannot be or efficiently harnessed.

Biomass Energy

Voice A

Biomass is the one and only renewable carbon resource on the earth. Biomass, similar to coal, natural gas or fuel oil, is primarily fired in boilers. Pennsylvanians use biomass primarily to generate heat, either on the smaller residential scale or on the institutional scale. Liquid biomass fuels, namely biofuels, involve briefly biodiesel and ethanol, which serve as substitutes respectively for diesel fuel or for gasoline powering vehicles. As we know, growing mobility in modern society consumes increasingly more energy. For instance, in the U. S. mobility consumes 70% of the oil use. Therefore, biofuels receive wide concern for its potential to alleviate the energy pressure from the increasing transportation need. Biomass energy is superior in its feedstock supply. Biofuels are appealing for two reasons.

(1) Feedstocks for biomass energy are diverse. In addition to corn and sug-

① pass n. 隘口

arcane, ethanol can be produced from such plentiful cellulosic① feedstocks as municipal waste (sewage sludge②), agricultural residue or waste, forest waste, manufacturing waste, (i. e., wood shavings, chipped wood from a furniture factory or a paper mill), fast-growing switchgrass③, oil-rich algae.

(2) Energy crops can be grown in marginal areas unsuited for food crop production. Although biofuels are not cost-competitive today, technological advance promises that ethanol will be an economical alternative for oil in the next few years and won't compete with food for cropland.

Voice B

A source is renewable if it is extracted at a rate no greater than it is replenished. Biomass energy should not be labeled as renewable given that the quantity of feedstocks for biomass energy is limited, especially that partial biodiesel is produced form human food, like soy, corn and other oil-producing plants which are insufficient to feed growing population.

Currently the important resources for biodiesels production in China are acid oil④ and illegal cooking oil⑤ (also called swill-cooked dirty oil), the output of which amounts to about 1,000 tons per year. Soybean oil, rapeseed oil⑥ and other raw materials can not be widely used for biodiesel refining in case of short supply of edible oils in long-term. Besides, supply shortage of raw materials is also a major bottleneck in the transformation of waste oil into biodiesel. Therefore, despite of promising prospect of biodiesels, shortage of raw material supply and narrow channels of acquisition make some refiners in "deficit" state for a long period.

---

① cellulosic a. 纤维素

② sewage sludge n. phr. 下水道污泥

③ switchgrass n. 柳枝稷，能源工程植物。美国本土的一种多年生植物，生长迅速、有强抗旱、盐碱能力，分布于美国得克萨斯州草原地区至加拿大，可用于提炼乙醇燃料。

④ acid oil n. phr. 酸化油，是指对油脂精炼厂所生产的的副产品进行酸化处理所的得到的油，主要工业用途是制造脂肪酸甲酯(生物柴油)，也用于生产油酸(用来制备塑料增塑剂、抗静电剂、农药乳化剂、复写纸、打字纸、圆珠笔油及各种油酸盐等)。

⑤ illegal cooking oil n. phr. 地沟油

⑥ rapeseed oil n. phr. 菜籽油

Geothermal Energy

Voice A

Inexhaustibility and renewability characterize geothermal energy. This energy comes from the decay of radioactive substance deep in the earth, so it is continuously replenished. The earth's geothermal resources are theoretically more adequate to supply humanity's energy need. This heat can be drawn from several sources: hot water or steam reservoirs deep in the earth that are accessed by drilling; geothermal reservoirs located near the earth's surface; and the shallow ground near the earth's surface that maintains a relatively constant temperature of 10 ~ 15°C. This variety of geothermal resources allows them to be used on both large and small scales.

Voice B

Geothermal energy is non-renewable for the following reasons.

(1) High temperature rocks contain tremendous heat, but only the reservoirs with enough hot water above the drilling well's depth are valuable for commercial development. Given that most of those rocks are either thousands of meters beneath the surface or impermeable①, substantial heat is unavailable with the current technology.

(2) Steam geothermal resource is the easiest one to be developed and the most efficient in thermoelectric conversion. However, there are only four or five identified steam geothermal reservoirs in the world.

(3) Geological features of geothermal energy decide that it is distributed to areas near tectonic plate② boundaries and far way from big cities where electricity demand is huge.

Ocean Energy

Voice A

Enormous clean energy exists in ocean. This energy includes tidal energy,

① impermeable a. 不透水的

② tectonic plate n. phr. 构造板块