普通高等教育科技英语系列规划教材

科技英语丛书

An Elementary Course of English for New Energy and New Material

新能源新材料专业英语基础教程

主　编　张　链　汪　磊
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中国科学技术大学出版社

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内 容 简 介

新能源、新材料的开发利用目前已成为全球发展的重点之一。顺应发展要求，本书用英语介绍了可再生能源、节能与环保技术、太阳能光伏发电、太阳能建筑一体化、新能源汽车技术及电气自动化等方面的知识及新技术和新动向。书中每单元后均附有练习题，便于复习巩固课文内容；此外还配有专业术语词汇表，且词汇覆盖面广。本书具有英语进阶、内容广泛、体系分明等特点。

本书内容相对基础，可供一般本科院校和高职高专类院校能源材料类专业的学生使用，也可供其他专业对新能源和新材料感兴趣的人士学习。

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Preface

前　言

新能源、新材料领域受到全球越来越多的关注。新能源、新材料技术的快速发展使相关基础建设和相关结构调整发生了巨大变化。很多国家对气候变迁、环境恶化、资源短缺所面临的挑战达成了共识并积极开展科研活动，期望能找到行之有效的方法来替代不可再生资源，以实现全人类的可持续发展。我国在“十二五”规划中也将此类学科列为发展重点，如何加快相关基础建设和相关结构调整，推动该领域生产和利用方式变革，绿色发展，建设资源节约型、环境友好型社会成为重中之重。正因为如此，国家高等职业教育也在进行相应的专业建设，部分学校已建立或者正在建设新能源、新材料类专业。这使得该类专业教学内容更加广泛，与国际接轨更加紧迫，所以我们编写了本教材。

本书的特点如下：

1. 英语进阶

本教材是为机电、新能源、新材料类专业的学生完成普通英语的学习课程，在具有一定的专业知识的基础上，进一步巩固和提高英语水平，特别是提高阅读科技文献及本专业英文资料的能力而编写的。

2. 内容广泛

书中内容参考了大量文献，内容丰富、新颖，广泛涉及相关领域的新技术和新动向，诸如可再生能源技术、太阳能技术、风电技术、生物质能技术、节能减排技术、汽车以及相关电气类技术等等。

3. 体系分明

本教材分为 4 部分(包括可再生能源技术、楼宇节能技术、太阳能及

太阳能汽车技术、相关电气技术)，共涉及约1000个专业词汇，专业词汇覆盖面广、生词重复率高、专业知识涵盖范围广。

本教材是根据编者多年的实际课堂教学经验总结编写出来的，编排力求保持该类专业知识的系统性和完整性，而且符合英语教学的特点。为便于不同层次的读者选择使用，每单元均配有正文、练习材料、专业术语解释和词汇表。

本教材由天津中德职业技术学院电气工程系张链、汽车航空系汪磊担任主编，天津中德职业技术学院电气工程系赵歆、王鹏担任副主编。本教材可供从事新能源、新材料类相关工作的人员参考使用，也可作为高等学校本科生、高职高专学生、业余大学和函授大学新能源、新材料、电气、汽车及交通运输等相关专业学生的教学、培训用书。

由于编者的水平及条件所限，加之时间仓促，难免有错漏或不当之处，诚望读者批评指正。

编　者

2012年1月

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Unit 1 Renewable Energy Commercialization

Introduction

Renewable energy commercialization involves the deployment of three generations of renewable energy technologies dating back more than 100 years, see Fig. 1. 1 and Fig. 1. 2. First-generation technologies, which are already mature and economically competitive, include biomass, hydroelectricity, geothermal power and heat. Second-generation technologies are market-ready and are being deployed at the present time; they include solar heating, photovoltaics, wind power, solar thermal power stations, and modern forms of bioenergy. Third-generation technologies require continued Research and Development (R&D) efforts in order to make large contributions on a global scale and include advanced biomass gasification, biorefinery technologies, hot-dry-rock geothermal power, and ocean energy.

Fig. 1. 1 The Wind, Sun and Biomass — three renewable energy sources

There are some non-technical barriers to the widespread use of renewables, and it is often public policy and political leadership that helps to address these barriers and drive the wider acceptance of renewable energy technologies. As of 2010, 98 countries have set targets for their own renewable energy futures, and have enacted wide-ranging public policies to promote renewables. Climate change concerns are driving increasing growth in the renewable energy industries. Leading renewable energy companies include First Solar, Gamesa, GE Energy, Q-Cells, Sharp Solar, Siemens, SunOpta, Suntech and Vestas.

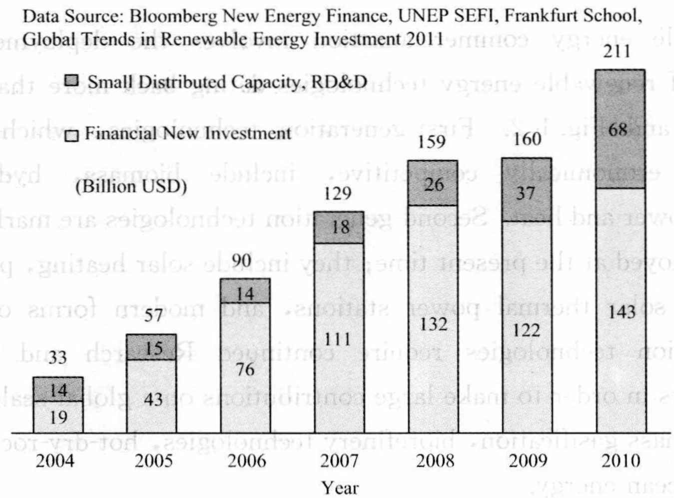

Fig. 1.2　Global new investment renewable energy

Total investment in renewable energy reached $211 billion in 2010, up from $160 billion in 2009. The top countries for investment in 2010 were China, Germany, the United States, Italy, and Brazil. Continued growth for the renewable energy sector is expected and promotional policies helped the industry weather the 2009 economic crisis better than many other sectors.

U. S. President Barack Obama's American Recovery and Reinvestment Act of 2009 included more than $70 billion in direct spending and tax credits for clean energy and associated transportation programs. Clean Edge suggests that the commercialization of clean energy has helped countries around the world pull out of the 2009 global financial crisis. Economic analysts expect market gains for renewable energy (and natural gas) following the 2011 Japanese nuclear accidents. Globally, there are an estimated 3 million direct jobs in renewable energy industries, with about half of them in the biofuels industry. According to a 2011 projection by the International Energy Agency, solar power generators may produce most of the world's electricity within 50 years, dramatically reducing harmful greenhouse gas emissions.

Lesson 1 Overview[1]

Rationale for renewables

Climate change, pollution, and energy insecurity are among the greatest current problems and addressing them requires major changes to energy infrastructures. Renewable energy technologies are essential contributors to the energy supply portfolio, as they contribute to world energy security, reduce dependency on fossil fuels, and provide opportunities for mitigating greenhouse gases. Climate-disrupting fossil fuels are being replaced by clean, climate-stabilizing, non-depletable sources of energy:

> ... the transition from coal, oil, and gas to wind, solar, and geothermal energy is well under way. In the old economy, energy was produced by burning something — oil, coal, or natural gas — leading to the carbon emissions that have come to define our economy. The new energy economy harnesses the energy in wind, the energy coming from the sun, and heat from within the earth itself.

A 2010 survey conducted by Applied Materials shows that two-thirds of Americans believe solar technology should play a greater role in meeting the country's energy needs. In addition, "three-quarters of Americans feel that increasing renewable energy and decreasing U. S. dependence on foreign oil are the country's top energy priorities". According to the survey, "67 percent of Americans would be willing to pay more for their monthly utility bill if their utility company increased its use of renewable energy".

Three generations of technologies

The term renewable energy covers a number of sources and technologies at different stages of commercialization. The International Energy Agency (IEA) has defined three generations of renewable energy technologies, dating back over 100 years:

- **First-generation technologies** emerged from the industrial revolution at the end of the 19th century and include hydropower, biomass combustion, geothermal power and heat. These technologies are quite widely used.
- **Second-generation technologies** include solar heating and cooling, wind power, modern forms of bioenergy, and solar photovoltaics. These are now entering markets as a result of research, development and demonstration (RD&D) investments since the 1980s. Initial investment was prompted by energy security concerns linked to the oil crises of the 1970s but the enduring appeal of these technologies is due, at least in part, to environmental benefits. Many of the technologies reflect significant advancements in materials.
- **Third-generation technologies** are still under development and include advanced biomass gasification, biorefinery technologies, concentrating solar thermal power, hot-dry-rock geothermal power, and ocean energy. Advances in nanotechnology may also play a major role.

First-generation technologies are well established, second-generation technologies are entering markets, and third-generation technologies heavily depend on long-term RD&D commitments, where the public sector has a role to play.

Growth of renewables

In 2011, UN under-secretary general Achim Steiner said: "The continuing growth in this core segment of the green economy is not happening by chance. The combination of government target-setting, policy support and stimulus funds is underpinning the renewable industry's rise and bringing the much needed transformation of our global energy system within reach." He added: "Renewable energies are expanding both in terms of investment, projects and geographical spread. In doing so, they are making an increasing contribution to combating climate change, countering energy poverty and energy insecurity".

During the five-years from the end of 2004 through 2009, worldwide renewable energy capacity grew at rates of 10 - 60 percent annually for many technologies (Table 1.1). For wind power and many other renewable technologies, growth accelerated in 2009 relative to the previous four years. More wind power capacity was added during 2009 than any other renewable technology. However, grid-connected PV increased the fastest of all renewables technologies, with a 60 percent annual average growth rate for the five-year period.

Table 1.1 Selected renewable energy indicators

Selected global indicators	2004	2005	2006	2007	2008	2009	2010
Investment in new renewable capacity (annual)	30	38	63	104	130	160	211 billion USD
Existing renewables power capacity, including large-scale hydro	895	930	1,020	1,070	1,140	1,230	1,320 GWe
Existing renewables power capacity, excluding large hydro					200	250	312 GWe
Hydropower capacity (existing)					950	980	1,010 GWe
Wind power capacity (existing)	48	59	74	94	121	159	198 GWe
Solar PV capacity (grid-connected)				7.6	16	23	40 GWe
Solar cell production (annual)					6.9	11	24 GWe
Solar hot water capacity (existing)	77	88	105	120	130	160	185 GWth
Ethanol production (annual)	30.5	33	39	50	67	76	86 billion liters
Biodiesel production (annual)					12	17	19 billion liters
Countries with policy targets for renewable energy use	45	49		68	79	89	98

In 2008, for the first time more renewable energy than conventional power capacity was added in both the European Union and the United States, demonstrating a "fundamental transition" of the world's energy markets towards renewables, according to a report released by REN21, a global renewable energy policy network based in Paris.

According to a 2011 projection by the IEA, solar power generators may produce most of the world's electricity within 50 years, dramatically reducing the emissions of greenhouse gases that harm the environment. Cedric Philibert, senior analyst in the renewable energy division at the IEA said: "Photovoltaic and solar-thermal plants may meet most of the world's demand for electricity by 2060 — and half of all energy needs — with wind, hydropower and biomass plants supplying much of the remaining generation". "Photovoltaic and concentrated solar power together can become the major source of electricity," Philibert said.

Economic trends

As of 2011, there have been substantial reductions in the cost of solar and wind technologies:

The price of Photovoltaic (PV) modules per MW_t has fallen by 60 percent since the summer of 2008, according to Bloomberg New Energy Finance estimates, putting solar power for the first time on a competitive footing with the retail price of electricity in a number of sunny countries. Wind turbine prices have also fallen — by 18 percent per MW in the last two years — reflecting, as with solar, fierce competition in the supply chain. Further improvements in the levelised cost of energy for solar, wind and other technologies lie ahead, posing a growing threat to the dominance of fossil fuel generation sources in the next few years.

The International Solar Energy Society (ISES) argues that renewable energy technologies and economics will continue to improve with time, and that they are "sufficiently advanced at present to allow for major penetrations of renewable energy into the mainstream energy and societal infrastructures". Indicative, levelised, economic costs for renewable power (exclusive of subsidies or policy incentives) are shown in the Table 1.2 below.

Table 1.2 Renewable power generation costs 2010

Power generator	Typical characteristics	Typical electricity costs (U. S. cents/(kW · h))
Large hydro	Plant size: 10 - 18,000 MW	3 - 5
Small hydro	Plant size: 1 - 10 MW	5 - 12
Onshore wind	Turbine size: 1.5 - 3.5 MW	5 - 9
Offshore wind	Turbine size: 1.5 - 5 MW	10 - 14
Biomass power	Plant size: 1 - 20 MW	5 - 12
Geothermal power	Plant size: 1 - 100 MW	4 - 7
Rooftop solar PV	Peak capacity: 2 - 5 kilowatts-peak	20 - 50
Utility-scale solar PV	Peak capacity: 200 kW to 100 MW	15 - 30
Concentrating solar thermal power (CSP)	50 - 500 MW trough	14 - 18

As time progresses, renewable energy generally gets cheaper while fossil fuels generally get more expensive. Al Gore has explained that renewable energy technologies are declining in price for three main reasons:

First, once the renewable infrastructure is built, the fuel is free forever. Unlike carbon-based fuels, the wind and the sun and the earth itself provide fuel that is free, in amounts that are effectively limitless.

Second, while fossil fuel technologies are more mature, renewable energy technologies are being rapidly improved. So innovation and ingenuity give us the ability to constantly increase the efficiency of renewable energy and continually reduce its cost.

Third, once the world makes a clear commitment to shifting toward renewable energy, the volume of production will itself sharply reduce the cost of each windmill and each solar panel, while adding yet more incentives for additional research and development to further speed up the innovation process.

Lesson 2 First-generation Technologies[2]

First-generation technologies are widely used in locations with abundant resources. Their future use depends on the exploration of the remaining resource potential, particularly in developing countries, and on overcoming challenges related to the environment and social acceptance.

Biomass

Biomass for heat and power is a fully mature technology which offers a ready disposal mechanism for municipal, agricultural, and industrial organic wastes. Take biomass heating plant in Austria for example (Fig. 1. 3), the total heat power is about 1,000 kW. However, the industry has remained relatively stagnant over the decade to 2007, even though demand for biomass (mostly wood) continues to grow in many developing countries. One of the problems of biomass is that material directly combusted in cook stoves produces pollutants, leading to severe health and environmental consequences; although improved cook stove programmes are alleviating some of these effects. First-generation biomass technologies can be economically competitive, but may still require deployment support to overcome public acceptance and small-scale issues.

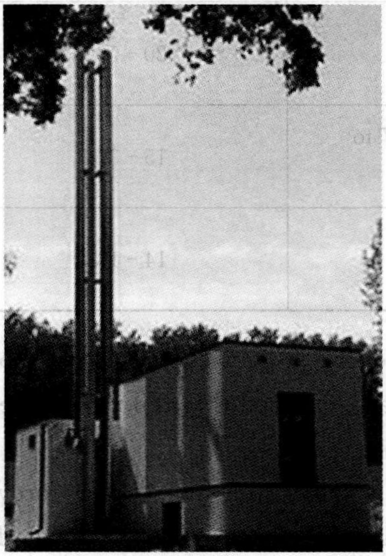

Fig. 1. 3 Biomass heating plant in Austria

Hydroelectricity

Hydroelectric plants have the advantage of being long-lived and many existing plants have operated for more than 100 years. Hydropower is also an extremely flexible technology from the perspective of power grid operation. Large hydropower provides one of the lowest cost options in today's energy market, even compared to fossil fuels and there are no harmful emissions associated with plant operation. The Hoover Dam in America is shown in Fig. 1. 4.

Hydroelectric power is currently the world's largest installed renewable source of electricity, supplying about 17% of total electricity in 2005. China is the world's largest producer of hydroelectricity in the world, followed by Canada.

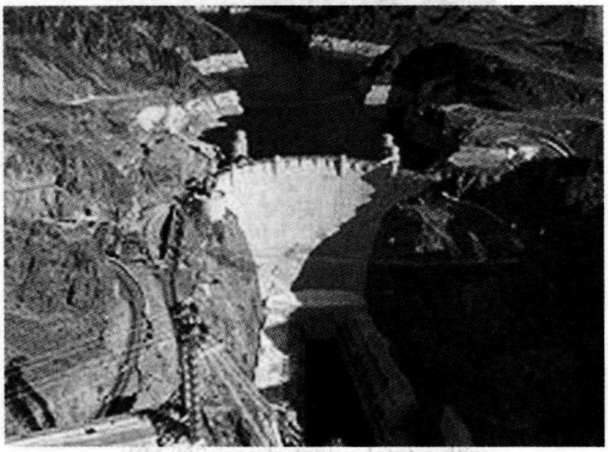

Fig. 1. 4 The Hoover Dam when completed in 1936 was both the world's largest electric-power generating station and the world's largest concrete structure

However, there are several significant social and environmental disadvantages of large-scale hydroelectric power systems: dislocation of people living where the reservoirs are planned, release of significant amounts of carbon dioxide and methane during construction and flooding of the reservoir, and disruption of aquatic ecosystems and birdlife. There is a strong consensus now that countries should adopt an integrated approach towards managing water resources, which would involve planning hydropower development in co-operation with other water-using sectors.

Geothermal power and heat

Geothermal power plants(Fig. 1. 5) can operate 24 hours per day, providing baseload capacity. Estimates for the world potential capacity for geothermal power generation vary widely, ranging from 40 GW to as much as 6,000 GW by 2020.

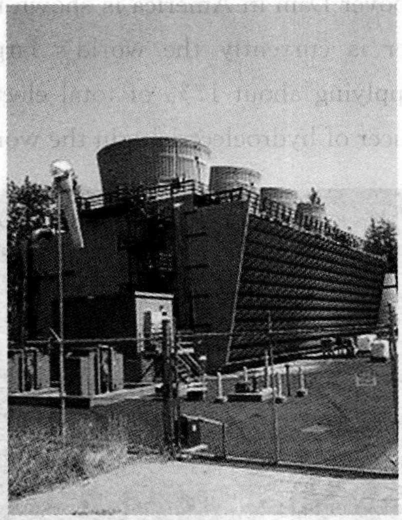

Fig. 1.5　One of many power plants at The Geysers, a geothermal power field in northern California, with a total output of over 750 MW

Geothermal power capacity grew from around 1 GW in 1975 to almost 10 GW in 2008. The United States is the world leader in terms of installed capacity, representing 3.1 GW. Other countries with significant installed capacity include Philippines (1.9 GW), Indonesia (1.2 GW), Mexico (1.0 GW), Italy (0.8 GW), Iceland (0.6 GW), Japan (0.5 GW), and New Zealand (0.5 GW). In some countries, geothermal power accounts for a significant share of the total electricity supply, such as in Philippines, where geothermal represented 17 percent of the total power mix at the end of 2008.

Geothermal (ground source) heat pumps represented an estimated 30 GWth of installed capacity at the end of 2008, with other direct uses of geothermal heat (i.e., for space heating, agricultural drying and other uses) reaching an estimated 15 GWth. As of 2008, at least 76 countries use direct geothermal energy in some form.