



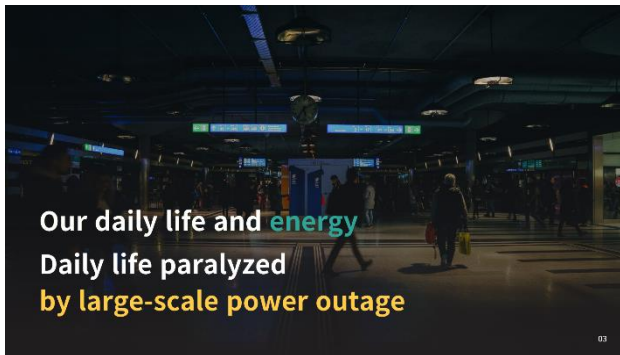
LEARN & ACT Teacher's Guide

Sustainable Energy

Contents

Introduction	1
1. Energy and Human Development	2
2. What is Fossil Energy?	3
3. What is Renewable Energy?	3
4. Global Energy Status	4
5. Causes of the Global Energy Crisis	6
6. International Goals for Sustainable Energy Production	6
7. The Most Important Thing for Sustainable Energy Use	7
8. Efforts of the International Community for Sustainable Energy Use	8
9. Sustainable Energy for All Humankind	10

Introduction 1: Living with Energy



▶ p.03

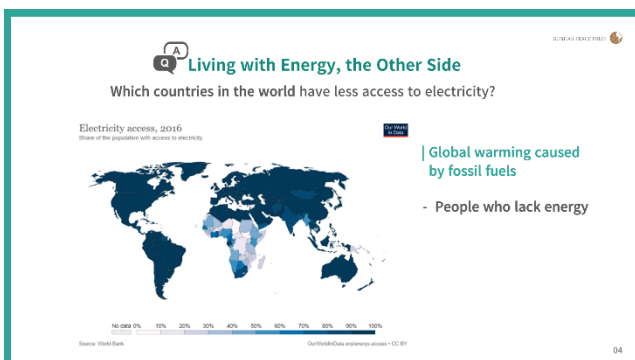
• Our daily life and energy:

We use energy every moment. “Energy helps children study even after dark. It makes it possible to pump up water for growing crops and plays a big role in storing food and medicines so that they do not spoil. Modern fuels for cooking and heating reduce the risk factors women meet with while transporting firewood over long periods of time (UN).” We use energy to drive cars and to travel in airplanes to distant countries. We are able to easily obtain real-time information with smartphones and computers. Today, our lives are connected through energy, and energy is very important for economic development and maintaining the security of each nation.

• Large-scale power outage paralyzed daily life:

If electricity consumption exceeds supply, power outages occur due to disruption in power supply. In 2003, large-scale power outages occurred in the northeastern United States and Ontario, Canada. At that time, 265 power plants stopped working, and the power supply network was restored three days later. During the three days of the blackout, cities fell into great chaos. As commuter train services were suspended and passengers flocked to taxis, cab drivers demanded exorbitant fares that were sixteen times the higher than usual, and gasoline prices soared by nearly 24% compared to the previous year. Aircraft operations were also suspended, and many factories closed, resulting in huge losses.

Introduction 2: Living with Energy, the Other Side



▶ p.04

• Global warming caused by fossil fuels:

Most of the energy used by humankind is made from fossil fuels. Fossil fuels, represented by coal and oil, emit huge amounts of greenhouse gas when burned, which is the main culprit in rising global temperatures. Global warming changes the entire ecosystem and poses a huge threat to the lives of humans, animals, and plants.

● **People with no access to energy:**

Despite the widespread increase in energy use throughout the globe, there are people who have no access to energy essential for basic living. One in seven people in the world does not have enough electric energy, and most of them are from underdeveloped and developing countries, making it difficult for them to lead humane lives.

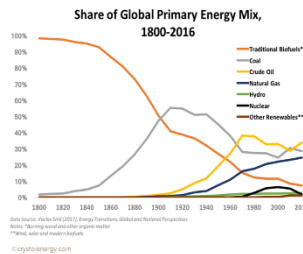
1. What is Energy?

01. Energy and Human Development

| **What is Energy?**

Energy refers to the force that enables an object to move or do work.

| **Energy and Human Development**



▶ p.05

● **What is energy? :**

Energy refers to the force that enables an object to move or do work. Energy exists in various forms and depending on its form is divided into kinetic energy, potential energy, thermal energy, electrical energy, and the like. Among these, the representative form used by human beings is “electrical energy.”

● **Energy and Human Development:**

Energy has greatly contributed to the development of humankind. After the industrial revolution powered by coal, mass production became possible through various means of transportation and factory systems, and human life became more prosperous. The emergence of large-scale printing and telegraph technologies accelerated industrial development (19th-century coal fuel era).

The electrical energy that we commonly use in our daily lives is produced through various methods in power plants. There are methods such as “hydroelectric power generation” that uses the kinetic energy of water to turn generators, “thermal power generation” that burns fossil fuels to turn generators, and “nuclear power generation” that uses energy generated during nuclear fission to run a generator (20th-century petroleum fuel era).

In the 21st century, humankind is actively developing and using new energy resources, represented by “solar power,” “wind power,” and “hydrogen.” Renewable energy is eco-friendly energy that does not generate carbon, and its development and use are expected to accelerate further to prevent climate change (Green energy era from the 21st century on).

2. What is fossil energy?

02. What is fossil energy?

| What is fossil energy?

Fossil fuels are fuels made by the remains of animals and plants buried in the ground long ago, which accumulated underground with heat and pressure
Ex) Coal, oil, and natural gas

-Fossil fuels, decreasing reserves

-Greenhouse gas emitted by fossil fuels
Fossil fuels = non-renewable energy



▶ p.06

● What is fossil energy? :

Fossil fuels are fuels made from the remains of animals and plants buried in the ground long ago, which accumulated underground with heat and pressure. Examples include coal, oil, and natural gas. Energy using fossil fuels is called fossil energy, which accounts for the largest proportion of energy currently used by humankind.

● Fossil fuels, decreasing reserves:

Fossil fuels are abundant because they are buried underground in a specific area on a large scale, are easy to store and transport, and also have high energy efficiency. However, as human beings are consuming it at a very rapid rate, the reserves are gradually decreasing. Experts predict that if consumption continues at the current rate, the oil will be depleted in 50.7 years, natural gas in 52.8 years, and coal in 114 years (BP Statistical Review of World Energy 2016).

● Greenhouse gas emitted by fossil fuels:

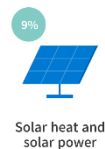
When fossil fuels are used, carbon dioxide is emitted, and the accumulation of carbon dioxide released into the atmosphere causes a greenhouse effect. For this reason, the temperature of the earth's surface and sea levels are rising, and the global ecosystem is rapidly being destroyed due to global warming.

3. What is renewable energy? (1)

03. What is renewable energy

| What is renewable energy?

Renewable energy refers to the energy that does not cause pollution in the process of utilization and that can be supplied indefinitely even if steadily consumed.



▶ p.07

● What is renewable energy? :

Renewable energy refers to the energy that does not cause pollution in the process of utilization and that can be supplied indefinitely even if steadily consumed. It is attracting attention as a new resource to replace fossil energy because of its cleanliness and no worry of depletion. However, its drawback is that the density of energy is too low to be used practically in places where a large amount of energy is required, so continuous research and development are required.

● **Types of renewable energy:**

Hydroelectric power (63%) is the most widely used renewable energy, followed by wind (19%), solar (9%), and bioenergy (8%) (IRENA 2018).

① **Hydroelectric power:**

It is a method of producing energy using the power of water to run a generator. After building a dam in the river, opening the sluice gate, the water moving at high speed is used to turn the turbine and produce energy.

② **Wind power**

It is a method of producing energy that utilizes the kinetic energy of wind. A windmill made of three blades spins by the force of the wind to operate a generator to produce energy.

③ **Solar heat and solar power:**

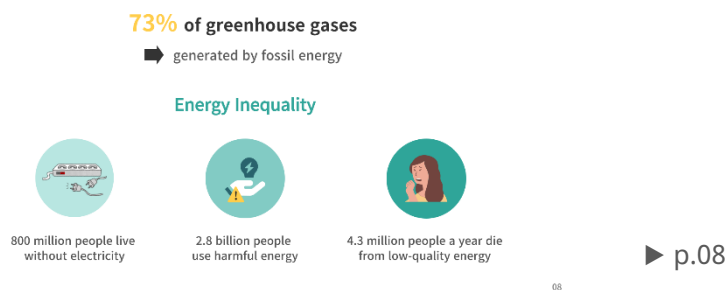
It is a method of producing energy that utilizes sunlight and its heat. It absorbs solar heat to heat water or collects sunlight using a heat collecting plate, stores it in solar cells, and uses it for energy production.

④ **Biomass:**

It is a method of producing energy that utilizes living organisms. Grains, fruits, trees, animal excrement, waste, etc. are converted into ethanol and methane gas and used as energy.

4. Global Energy Status (1) (Source: UN)

04. Global Energy Status (1) (Source: UN) SUNHAK PEACE PRIZE



● **73% of greenhouse gases are generated by fossil energy:**

Fossil energy is the main culprit of global climate change. 73% of the greenhouse gases that cause global warming come from fossil energy used by humans.

● **Unequal energy:**

Energy use shows unequal patterns. Energy waste is rampant in developed countries, while in developing countries, it is difficult to improve productivity and achieve economic growth due to the inability to secure energy stably.

① **800 million people live without electricity:**

10% of the world's population (789 million people) live without electricity, and 50% of them live in sub-Saharan Africa (as of 2018).

② 2.8 billion people use harmful energy:

About 2.8 billion people, one-third of the world's population, use unsanitary and harmful fuels such as wood, charcoal, coal, and animal excrement for cooking.

③ 4.3 million people a year die from the use of low-quality energy:

Many people around the world are using low-quality, combustible fuels that emit toxic gases indoors. In 2012 alone, 4.3 million people died from low-quality combustible fuels, of which 60% were women and girls.

4. Global Energy Status (2) (Source: UN)

04. Global Energy Status (2) (Source: UN)



01. Increasing energy efficiency can reduce greenhouse gases by 40%
02. Renewable energy produces 17.5% of the world's electricity
03. Creation of jobs through renewable energy, 18 million



▶ p.09

09

● Increasing energy efficiency can reduce greenhouse gases by 40%:

In order to solve the climate problem, active efforts to increase energy efficiency are required. Rational policies to increase energy efficiency can reduce greenhouse gas emissions by more than 40% without developing new technologies.

● Renewable energy produces 17.5% of the world's electricity:

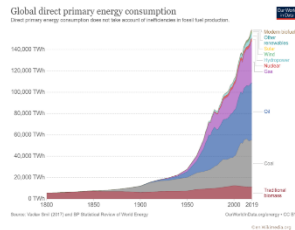
As of 2017, 17.5% of the world's electricity was produced by renewable energy. However, to overcome the climate crisis, the use of renewable energy needs to be improved further. The International Renewable Energy Agency (IRENA) argues that the share of renewable energy among all energies should be increased to two-thirds by 2050.

● Creation of jobs through renewable energy

The rate of global renewable energy use has steadily increased due to the steady efforts to solve the global energy crisis. The renewable energy sector employed 11.5 million people in 2019 and has the potential to create 18 million more jobs in the future.

5. Causes of the Global Energy Crisis

05. Causes of the Global Energy Crisis



- 01. Rapid increase in energy demand
- 02. Habits of wasting energy
- 03. Old power generation infrastructure

10

▶ p.10

● A rapid increase in energy demand:

As of 2021, the world's population is about 7.88 billion people. The UN predicted in its 2019 world population growth data that the world population will reach about 9.7 billion by 2050. This is about a 10-fold increase compared to before the Industrial Revolution, and energy demand is expected to increase further in proportion to the growing population.

● Habits of wasting energy:

Habits of wasting energy are widespread around the world. Humans are consuming enormous amounts of energy in all areas of daily life (household) and industry (industrial). In particular, the reserves of fossil fuels such as coal, oil, and natural gas are gradually decreasing due to excessive consumption by humankind. These are all non-renewable energy that disappears once used.

● Old power generation infrastructure:

Most energy-producing companies around the world continue to use old equipment, which reduces the efficiency of energy production and causes energy shortages.

6. International Goals for Sustainable Energy Production

06. International Goals for Sustainable Energy Production



| SDGs #7 “Sustainable and clean energy”

“Sustainable and clean energy” means energy such as solar power and wind power that we can continue to use without depletion and that does not emit pollutants

11

▶ p.11

● UN Sustainable Development Goal #7, “Sustainable and Clean Energy”:

The Sustainable Development Goals (SDGs), an agenda the UN General Assembly decided in 2015 to achieve by 2030 are 17 common goals of humankind for realizing the ideology of sustainable development. Among them, the seventh goal is “Affordable and Clean Energy.”

● **The meaning of “sustainable and clean energy”:**

“Sustainable and clean energy” means energy such as solar power and wind power that can be used forever without depletion and that does not emit pollutants.

06. International Goals for Sustainable Energy Production



SDGs Indicators

- 7.1 Ensure universal access to affordable, reliable, and modern energy services by 2030.
- 7.2 Significantly increase the share of renewable energy in the global energy mix (diversification of energy sources) by 2030.
- 7.3 Double the global rate of improvement in energy efficiency by 2030.
- 7.a. By 2030, strengthen international cooperation to promote access to clean energy research and technological development, including renewable energy, energy efficiency, advanced and cleaner fossil fuel technologies, and investment in energy infrastructure and clean energy technologies.
- 7.b. By 2030, develop technologies and expand infrastructure to provide modern and sustainable energy services to all in accordance with national support programs in developing countries, particularly least developed countries, small island developing countries, and landlocked developing countries.

12

▶ p.12

● **SDGs 7 Indicators**

- 7.1 Ensure universal access to affordable, reliable, and modern energy services by 2030.
- 7.2 Significantly increase the share of renewable energy in the global energy mix (diversification of energy sources) by 2030.
- 7.3 Double the global rate of improvement in energy efficiency by 2030.
- 7.a. By 2030, strengthen international cooperation to promote access to clean energy research and technological development, including renewable energy, energy efficiency, advanced and cleaner fossil fuel technologies, and investment in energy infrastructure and clean energy technologies.
- 7.b. By 2030, develop technologies and expand infrastructure to provide modern and sustainable energy services to all in accordance with national support programs in developing countries, particularly least developed countries, small island developing countries, and landlocked developing countries.

7. The Most Important Thing for Sustainable Energy Use

07. The Most Important Thing for Sustainable Energy Use

- Transition to renewable energy that can be self-sufficient
- Resolving environmental and resource depletion problems
- International cooperation for the development of renewable energy

13

▶ p.13

● **Transition to renewable energy that can be self-sufficient:**

With renewable energy use systems, everyone can consume and produce energy at the same time. An energy self-sufficient system through renewable energy will create a sustainable energy environment for humankind.

- **Resolving environmental and resource depletion problems:**

Fossil energy raises global temperature, destroys ecological order, and threatens the very existence of humankind. In addition, depletion is a serious problem. However, renewable energy using nature can be produced perpetually without emitting pollutants, so it can be a solution to global environmental problems and depletion problems.

- **International cooperation for the development of renewable energy:**

In order to use renewable energy efficiently, it is essential to develop related technologies and spread them around the world. An international technical cooperation system should be established so that countries that do not have renewable energy technologies do not fail to secure future energy resources.

8. Efforts of the International Community for Sustainable Energy Use (1. Campaigns)

08. Efforts of the International Community for Sustainable Energy Use



1. Campaigns



Pursuit of carbon neutrality
Carbon neutrality is the concept of making carbon dioxide emissions "zero."

RE 100

RE100 Campaign
The goal of supplying 100% of the electricity used by businesses with renewable energy by 2050

▶ p.14

14

- **Pursuit of carbon neutrality**

Carbon neutrality is the concept of making carbon dioxide emissions "zero." The plan is to increase the absorption amount of carbon dioxide emitted by companies and individuals and neutralize the total amount of carbon dioxide by making it zero. Many countries around the world are pursuing carbon neutrality by planting trees to absorb emitted carbon dioxide, or by using various types of renewable energy instead of fossil energy. After the Paris Climate Agreement took effect in 2016, 121 countries joined the "2050 Carbon Neutral Target Climate Alliance," and after that, major countries such as those in the European Union, China, and the Republic of Korea joined the declaration of carbon neutrality. As a result, the world has been moving more actively toward developing renewable energy and building its infrastructure.

- **RE100 Campaign:**

RE100 is an abbreviation for "100% Renewable Energy." The Climate Group, a British multinational non-profit organization, was launched in 2014 as an international campaign with the goal of supplying 100% of the electricity used by businesses with renewable energy by 2050. In order to achieve RE100, companies are either building their own renewable energy power generation facilities or are applying electricity consumption methods produced by renewable energy power plants to the production process. Global companies such as Apple, Google, IKEA, Nike, and Johnson & Johnson are voluntarily participating and contributing to the spread of renewable energy use.

8. Efforts of the International Community for Sustainable Energy Use (2. International Organizations and Groups)

08. Efforts of the International Community for Sustainable Energy Use

2. International Organizations

1) International Energy Agency (IEA)

Preparation of rational energy policies, and cooperation in energy technology among countries



2) International Renewable Energy Agency (IRENA)

Strengthening international cooperation for the development and supply of renewable energy



▶ p.15

● International Energy Agency (IEA):

Founded in 1974, the International Energy Agency is an intergovernmental organization under the OECD and is an energy organization encompassing the world. In order to encourage renewable energy development, preparation of rational energy policies, and cooperation in energy technology among countries, it collects and analyzes various data such as global energy use trends and energy-related technology and provides various solutions. As of 2021, 30 countries are members of the organization.

● International Renewable Energy Agency (IRENA):

Established in 2011, the International Renewable Energy Agency is an international organization with the purpose of strengthening international cooperation for the development and supply of renewable energy. It is calling for global adoption and sustainable use of various forms of renewable energy, including bioenergy and geothermal, hydroelectric, solar, and wind energy. It is moving toward a global supply of sustainable energy by encouraging governments to stimulate investment in renewable energy, providing advice on building relevant infrastructure, and promoting knowledge sharing and technology transfer.

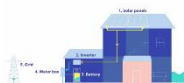
8. Efforts of the International Community for Sustainable Energy Use (3. Various Ideas)

08. Efforts of the International Community for Sustainable Energy Use

3. Various Ideas

1) Micro-Grid

"Small-scale independent power system" for self-sufficiency in the production and consumption of electricity in individual buildings, remote areas, and independent industrial complexes



2) African Clean Energy (ACE)

High-efficiency stove using biomass fuel



▶ p.16

● Micro-Grid:

Most of the electricity we use is supplied through a centralized power grid. In contrast, a microgrid is a power grid that supplies energy based on a "small-scale independent power system." It is mainly used for self-sufficiency in the production and consumption of electricity in individual buildings, remote areas, and independent industrial complexes. Since electricity is independently produced, supplied, and stored, a stable supply and demand of energy are possible, and the surplus electricity can be sold to other nearby consumers, thereby compensating for the lack of energy in the existing power system. In particular, it is an alternative to various energy crises that humankind is experiencing because it generates electricity using renewable energy such as solar power or wind power.

- **African Clean Energy (ACE):**

Founded in 2011, "African Clean Energy" has developed a high-efficiency stove using biomass fuel and is supplying it to sub-Saharan Africa, which is suffering from energy poverty. This stove, which burns gas by using fuel such as animal excrement or wood chips, produces less smoke and is highly efficient, making it a new energy alternative in Africa.

9. Sustainable Energy for All Humankind (Brainstorm)



▶ p.17