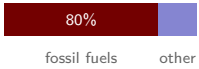
Energy Resources and Consumption

AP Environmental Science ▪ Unit 6

AP Environmental Science

What we will cover

1. Renewable vs nonrenewable
2. Fossil fuels
3. Nuclear power
4. Solar and wind
5. Hydro and geothermal
6. Biomass and conservation



Renewable vs nonrenewable

The split is a race of two rates – use vs **replenishment** 补充:

- **renewable** 可再生: refills as fast as we use it (sun, wind)
- **nonrenewable** 不可再生: forms far slower (fossil fuels)

> **Fossil fuels** 化石燃料 still supply $\sim 80\%$ of world energy – cheap and energy-dense.

renewable nonrenewable

Fossil fuels

Buried life, pressed for *millions* of years into coal, oil, gas.

- **extraction** 开采: mine coal, pump oil & gas
- burn → steam → turbine → electricity

> Burning releases **carbon dioxide** 二氧化碳 plus **pollutants** 污染物.

Fossil fuels: energy-dense but nonrenewable

Nuclear power

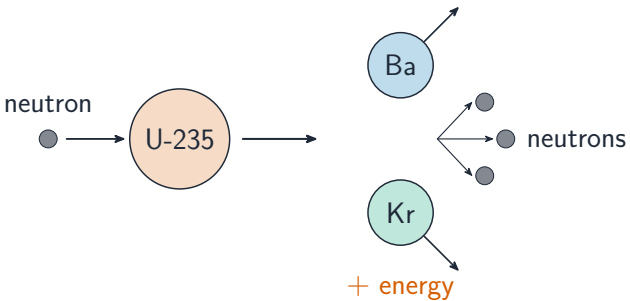
Nuclear power 核能 uses **fission** 核裂变: a neutron splits a uranium nucleus, releasing huge heat.

- almost no **greenhouse gas** 温室气体
- but **radioactive waste** 放射性废物 lasts $10{,}000+$ years

> Low-carbon and steady, but waste storage and accidents are the risks.

Nuclear: steady low-carbon power, long-lived waste

Nuclear power



Solar and wind

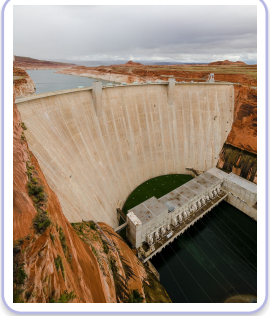
Solar PV: clean but intermittent

Photovoltaic cells 光伏电池 turn light to electricity; need storage at night.

Wind: kinetic energy on coasts & ridges

No fuel once built – but both need backup for calm, dark hours.

Hydro and geothermal



Hydro: reliable, but floods valleys A **dam** 大坝 drops water through turbines.

Geothermal: Earth's heat near plates

Only works where hot rock is shallow.

Biomass, hydrogen, conservation

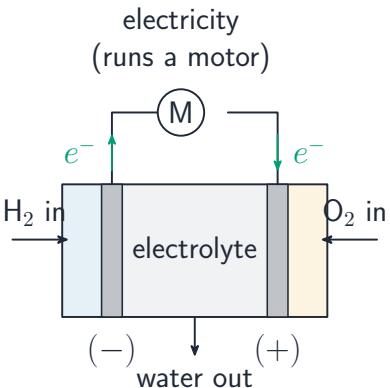
Biomass 生物质 burns stored chemical energy; ferment crops to **ethanol** 乙醇. A **hydrogen fuel cell** 氢燃料电池 makes only water:

$$2\,H_2 + O_2 \rightarrow 2\,H_2O$$

> The cleanest energy is the energy we never use – **energy conservation** 能源节约.

Conservation + renewables: efficiency first

Biomass, hydrogen, conservation



overall: $2H_2 + O_2 \rightarrow 2H_2O$

Worked example – energy and cost

A $100\ \mathrm{W}$ bulb runs 10 hours a day. Find its yearly energy use, and the saving from a $15\ \mathrm{W}$ LED at \$0.12/kWh.

- Daily:
  $100\ \mathrm{W} \times 10\ \mathrm{h} = 1000\ \mathrm{Wh} = 1\ \mathrm{kWh}.$
- Yearly: $1 \times 365 = 365\ \mathrm{kWh}$; the LED uses $0.15 \times 365 = 54.75\ \mathrm{kWh}$.
- Energy saved
  $= 365 - 54.75 = 310.25\ \mathrm{kWh}$
- Cost saved
  $= 310.25 \times 0.12 = \$37.23$ per year

Watch the units: $\mathrm{W} \times \mathrm{h} = \mathrm{Wh}$, then $\div 1000$ for kWh. Show every conversion – APES gives marks for the setup, not just the number.

Unit 6 – key takeaways

1 Fossil fuels

$\sim$80% of energy; nonrenewable; CO_2 + pollutants

2 Nuclear

fission: low-carbon but long-lived waste

3 Renewables

solar/wind intermittent; hydro/geothermal reliable

4 Cleaner still

hydrogen $\rightarrow$ water; conservation is cheapest

Check yourself

1. About what share of world energy is fossil fuels?
2. What process powers a nuclear plant?
3. Why do solar and wind need backup?
4. What is the only byproduct of a hydrogen fuel cell?

Answers **1.** about 80% **2.** nuclear fission **3.** they are intermittent **4.** water