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# **Module -4**

## **ENERGY RESOURCES**

## **RENEWABLE RESOURCES**

**By**

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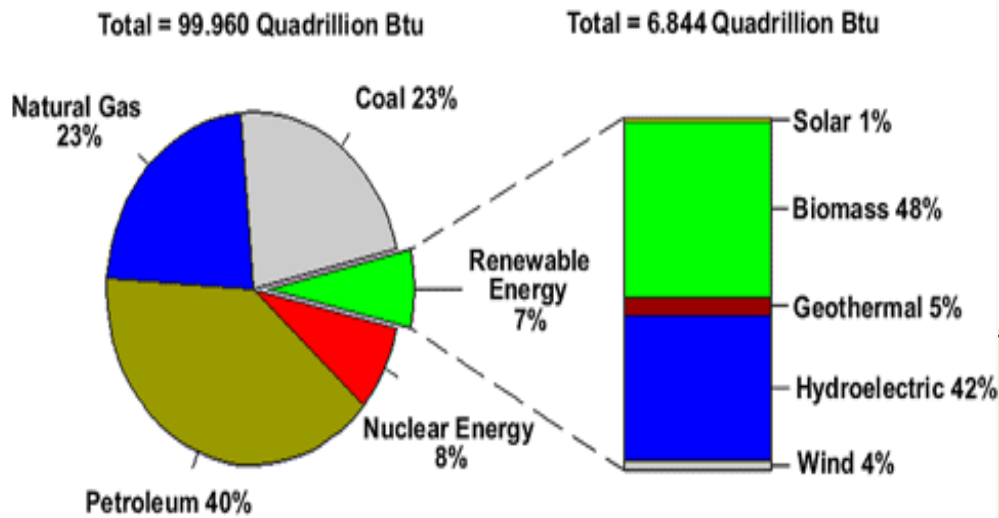
# Contents

- Solar energy
- Hydroelectric power
- Ocean thermal energy
- Wind and geothermal energy.
- Energy from biomass
- solar-Hydrogen revolution.

# Shift of Renewable resources

- Result in a more decentralized and efficient energy economy that is less vulnerable to supply cut offs from terrorist attacks and natural disasters such as hurricanes.
- Improve national security by reducing the need to import oil from the Middle East.
- Reduce trade deficits resulting from importing oil.
- Greatly reduce air pollution and emissions of greenhouse gases.
- Create large numbers of high-paying jobs for skilled workers.
- Save consumers money.

# Fastest growing energy resources

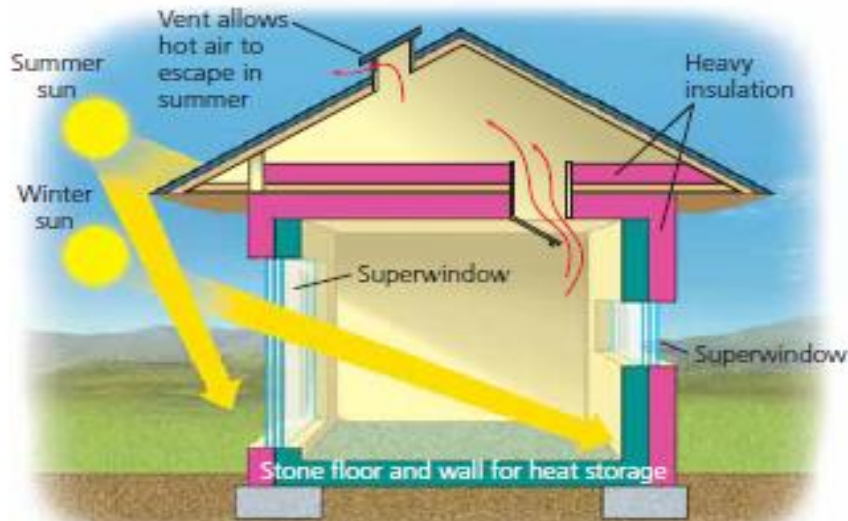


**Total Costs of Electricity from Different Sources in 2004 (U.S. cents per kilowatt hour) \***

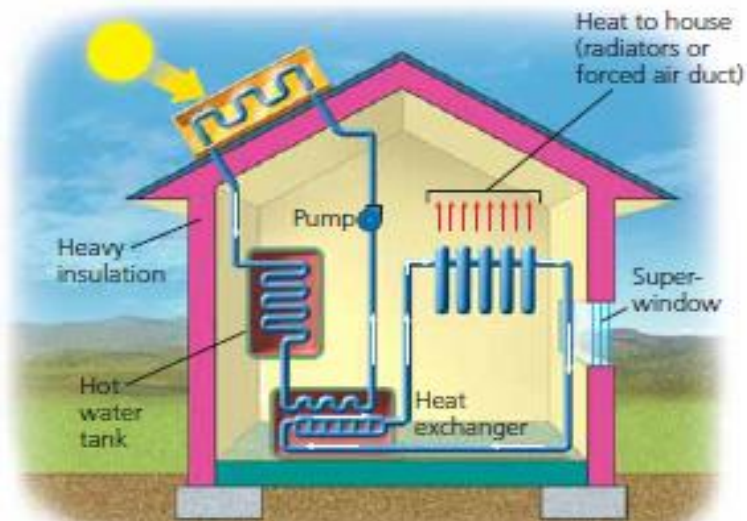
Electricity Source	Generating Costs	Environmental Costs	Total Costs
Wind	3-7	0.1-0.3	3.1-7.3
Hydropower	3-8	0-1.1	3.0-9.1
Geothermal	5-8	1 (approx.)	6.0-9.0
Natural gas	5-7	1.1-4.5	6.1-11.5
Coal	4-6	2.3-17.0	6.3-23.0
Biomass	6-9	1.0-3.4	7.0-12.4
Nuclear fuel cycle	8-12	0.2-0.7	8.2-12.7
Solar cells	12-26	0.7	12.7-26.7

\*Data from U.S. Department of Energy and a variety of sources compiled by the Worldwatch Institute; from the latest year for which all such data are available.

# Passive and active solar heating system



PASSIVE



ACTIVE

## Passive or Active Solar Heating

### Advantages

- Energy is free
- Net energy is moderate (active) to high (passive)
- Quick installation
- No CO<sub>2</sub> emissions
- Very low air and water pollution
- Very low land disturbance (built into roof or windows)
- Moderate cost (passive)



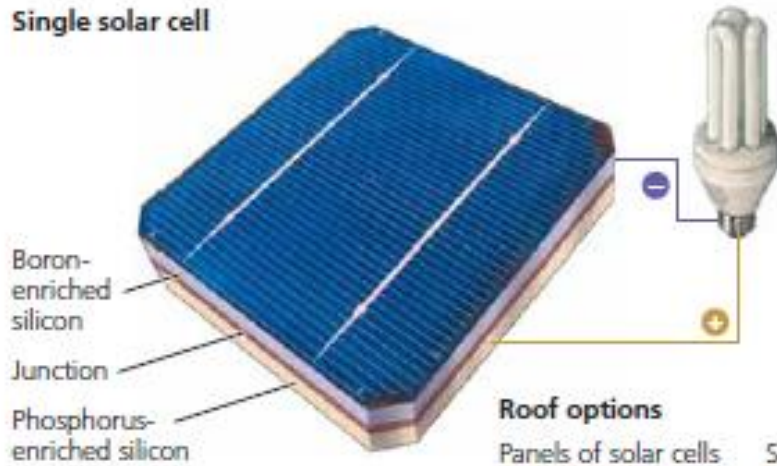
### Disadvantages

- Need access to sun 60% of time
- Sun can be blocked by trees and other structures
- Environmental costs not included in market price
- Need heat storage system
- High cost (active)
- Active system needs maintenance and repair
- Active collectors unattractive



# Devices- PV effect

Single solar cell



Solar-cell roof



Roof options

Panels of solar cells



Solar shingles



**Figure 13-30 Solutions:** solar cells used to provide electricity for a remote village in Niger, Africa. **Question:** Do you think your government should aid poor countries to obtain such solar cells? Explain.

# TRADE-OFFS

## Solar Cells

### Advantages

Fairly high net energy yield

Work on cloudy days

Quick installation

Easily expanded or moved

No CO<sub>2</sub> emissions

Low environmental impact

Last 20–40 years

Low land use (if on roof or built into walls or windows)

Reduces dependence on fossil fuels



### Disadvantages

Need access to sun

Low efficiency

Need electricity storage system or backup

Environmental costs not included in market price

High costs (but should be competitive in 5–15 years)

High land use (solar-cell power plants) could disrupt desert areas

DC current must be converted to AC

# Electricity from free flowing water- Hydroelectric power

- Hydropower uses the kinetic energy of flowing and falling water to produce electricity.
- Common way to harness- high dam across a large river
- Second cheapest way to produce electricity – hydropower.
- **Five top producers – Canada, china, Brazil, US and Russia.**



# Large-Scale Hydropower

## Advantages

Moderate to high net energy

High efficiency (80%)

Large untapped potential

Low-cost electricity

Long life span

No CO<sub>2</sub> emissions during operation in temperate areas

Can provide flood control below dam

Provides irrigation water

Reservoir useful for fishing and recreation



## Disadvantages

High construction costs

High environmental impact from flooding land to form a reservoir

Environmental costs not included in market price

High CO<sub>2</sub> emissions from rapid biomass decay in shallow tropical reservoirs

Danger of collapse

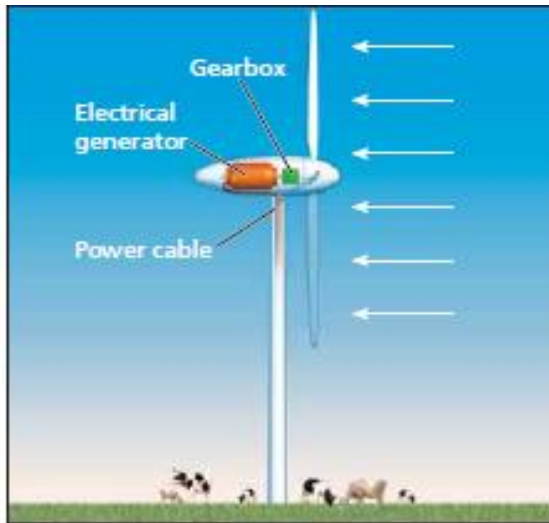
Uproots people

Decreases fish harvest below dam

Decreases flow of natural fertilizer (silt) to land below dam

# Wind power- path of sustainability in present world

- The difference in solar heating of the earth between the equator and the poles, together with the earth's rotation create flow of air called as wind.
- Indirect of form of solar energy. (wind turbines to electrical energy)
- Largest wind power producers – Germany, Spain, US and **INDIA.**



Wind turbine



Wind farm



Wind farm (offshore)

# Wind Power

## Advantages

Moderate to high net energy yield

High efficiency

Moderate capital cost

Low electricity cost (and falling)

Very low environmental impact

No CO<sub>2</sub> emissions

Quick construction

Easily expanded

Can be located at sea

Land below turbines can be used to grow crops or graze livestock



## Disadvantages

Steady winds needed

Backup systems needed when winds are low

Plastic components produced from oil

Environmental costs not included in market price

High land use for wind farm

Visual pollution

Noise when located near populated areas

Can interfere with flights of migratory birds and kill birds of prey

# Solid Biomass

- Consists of plant materials– wood & agriculture waste and animal waste – burned directly as a solid fuel or converted into gaseous or liquid biofuels.
- Biomass is indirect – solar energy bec' it consists of combustible organic compounds produced by photosynthesis.
- Biomass is burned mostly by heating and cooking.
- Industrial process- generate electricity.
- Wood, charcoal, animal manure- used for heating and cooking.
- 10% energy world's , 35% developing countries and 95% poor countries.
- Cottonwoods, poplars, sycamores –fast growing plants.
- Crop residues- sugarcane residues, rice husks, cotton stalks and coconut shells.



# Solid Biomass

## Advantages

Large potential supply in some areas

Moderate costs

No net CO<sub>2</sub> increase if harvested and burned sustainably

Plantation can be located on semiarid land not needed for crops

Plantation can help restore degraded lands

Can make use of agricultural, timber, and urban wastes



## Disadvantages

Nonrenewable if harvested unsustainably

Moderate to high environmental impact

Environmental costs not included in market price

CO<sub>2</sub> emissions if harvested and burned unsustainably

Low photosynthetic efficiency

Soil erosion, water pollution, and loss of wildlife habitat

Plantations could compete with cropland

Often burned in inefficient and polluting open fires and stoves



# Geothermal Energy

**WHAT DOES THE WORD "GEOTHERMAL" MEAN?**

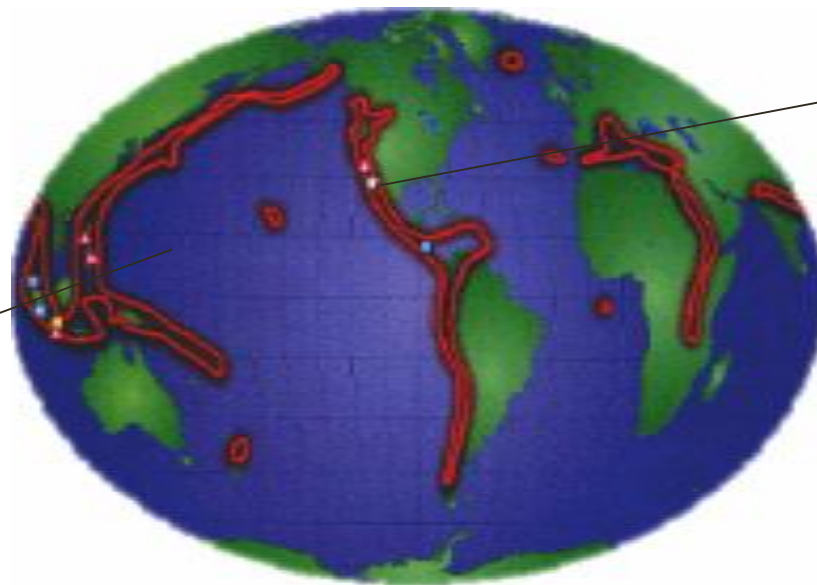
*Geo = Earth Thermal = Heat*

**WHAT IS GEOTHERMAL ENERGY?**

*Energy that can be extracted from the hot rocks present inside the earth is called geothermal energy.*

**How it will happen?**

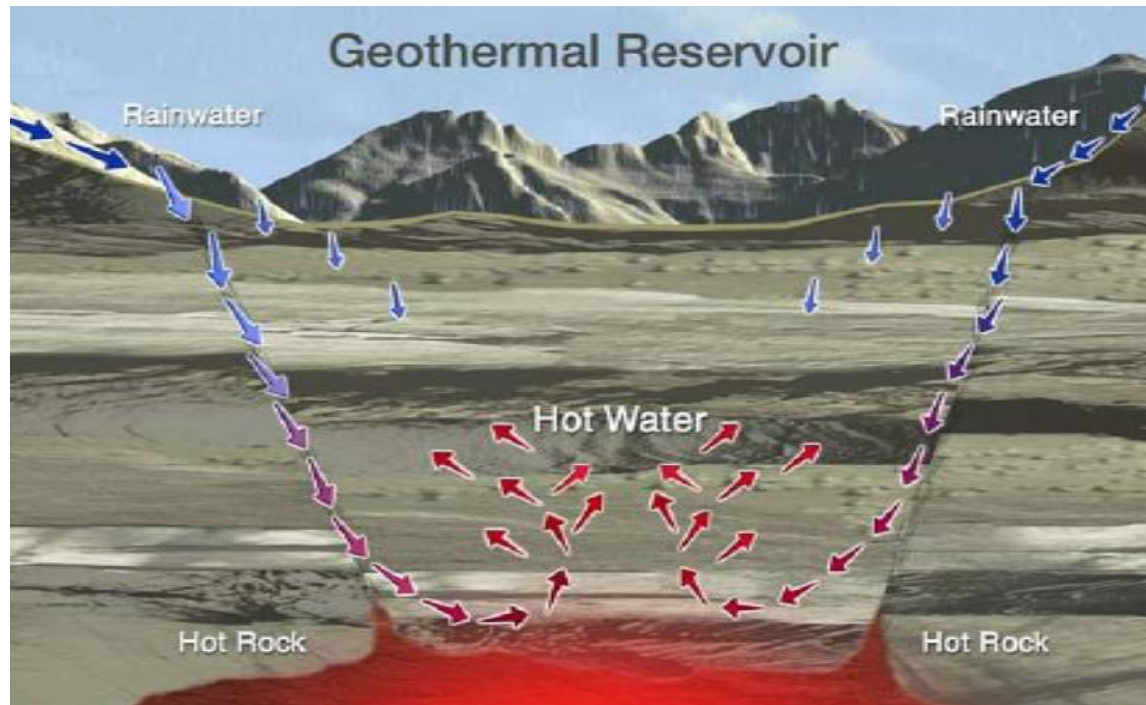
*Where the earth's tectonic plates collide and one slides beneath another. The best example of these hot regions is the Pacific Ring of Fire.*



Arizona

Pacific ring of  
fire

- ✓ This heat comes from the fission of radioactive materials naturally present in the rocks.
- ✓ In some places, the steam or hot water comes out of the ground naturally through cracks in the form of natural geysers. Example: Manikaran, Kullu, Sohana, Haryana.
- ✓ Sometime it will not find place to come out. There we have to make hole by artificial drilling in the hot rocks and gush out the water through pipe at high pressure which turns the turbine of a generator to produce electricity.
- ✓ In USA and New Zealand several geothermal plants are working successfully.



## *HOW DID PEOPLE USED GEOTHERMAL ENERGY IN THE PAST?*

Bathing

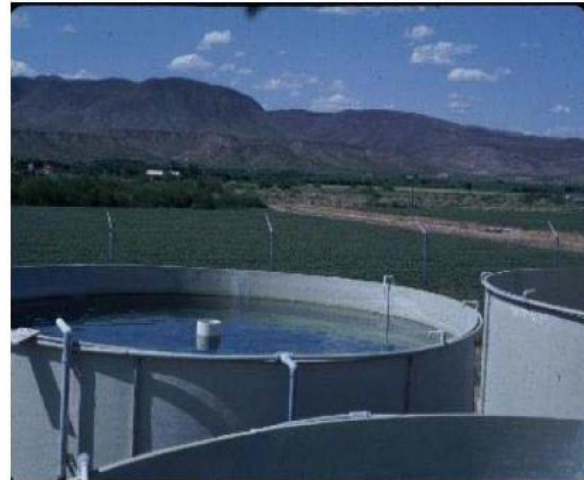
Medicine



# HOW DO WE USE GEOTHERMAL ENERGY TODAY?

1. *Space Heating/Cooling*
2. *Water Heating*
3. *Aquaculture : Fish, Shrimp, Abalone, Alligators*
4. *Drying of fruits / vegetables / lumber*
5. *Industrial Uses: Dying of cloth, washing wool, piping under sidewalks to keep from freezing, manufacturing paper*
7. *Electricity Generation*

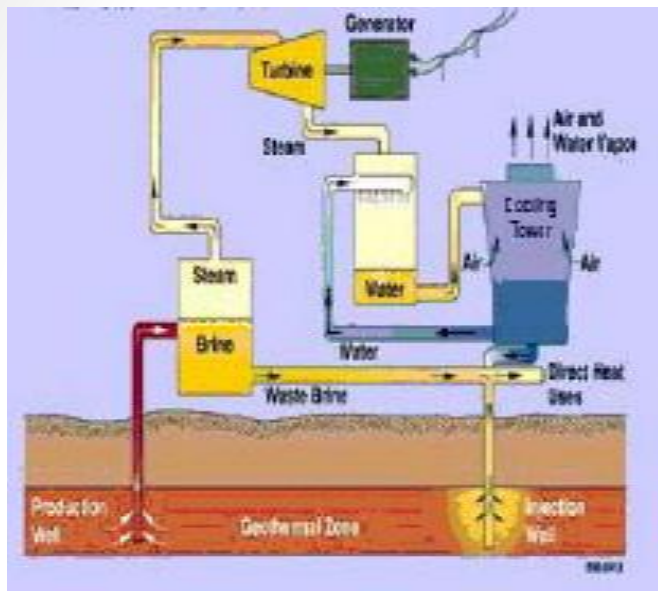
## TILAPIA FARM SAFFORD



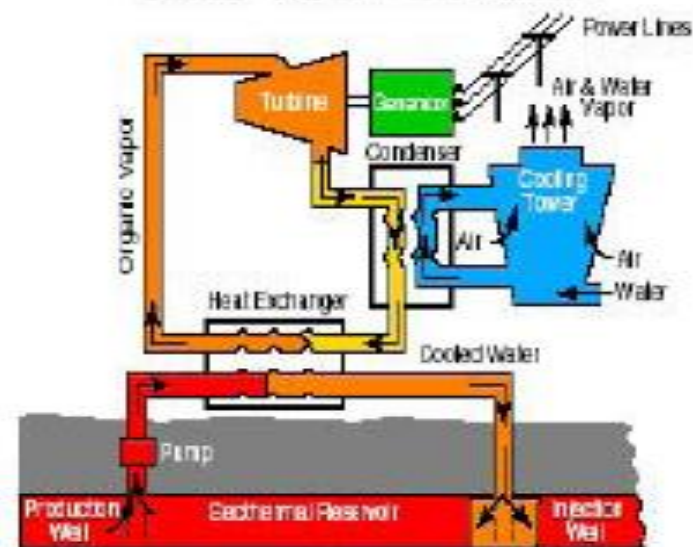


# HOW IS ELECTRICITY GENERATED USING GEOTHERMAL ENERGY?

## Flash steam power plant

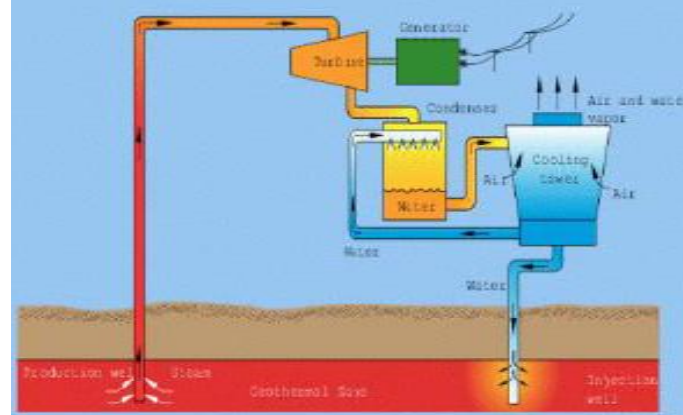


## Binary-Cycle Power Plant



## Dry Steam Power Plant

## Dry steam power plant





## WHAT ARE SOME OF THE ADVANTAGES OF USING GEOTHERMAL ENERGY TO GENERATE ELECTRICITY?

### ☐ *Clean:*

*No emissions, safe to use*

### ☐ *Reliable:*

*Continuous, reliable base-load power*

### ☐ *Sustainable / Reusable:*

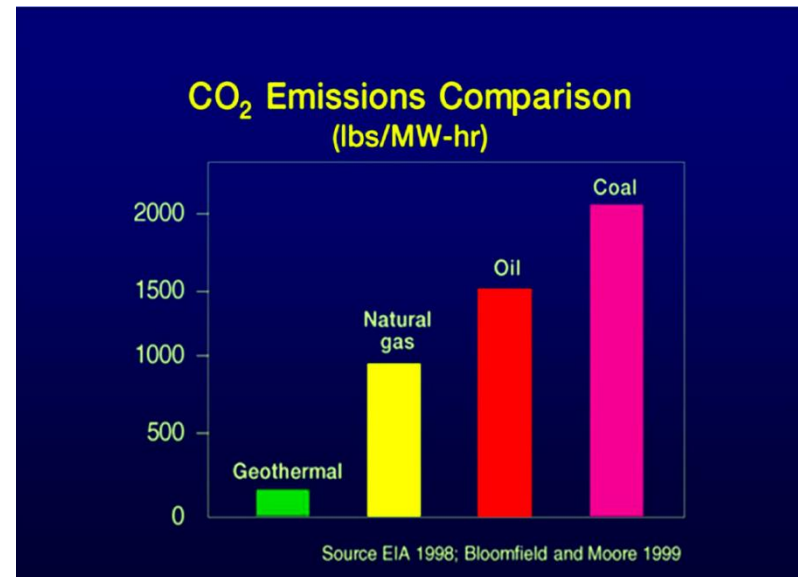
*Water can be recycled back into the earth and reused No other fuel mixture required to create electricity*

### ☐ *Land Conservative:*

*No major land requirements. Can be integrated into the local area with no adverse effects*

### ☐ *Flexible / Modular:*

*Geothermal power plants can have modular designs, with additional units installed in increments when needed to fit growing demand for electricity*



# Thank You