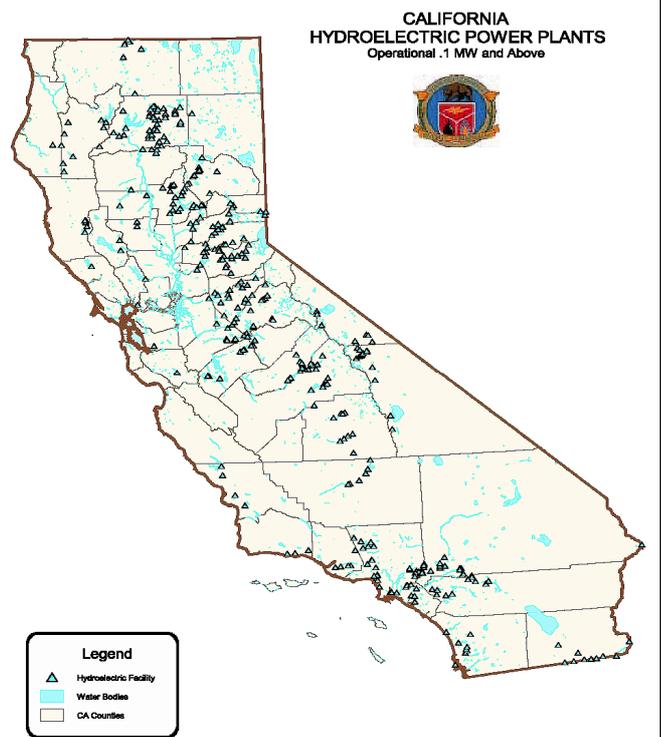


HYDROELECTRIC POWER (HEP)

- The HEP production in California contributes around 15% of the total energy needs of the state
- This energy is renewable and does not involve the burning of fossil fuels, has no carbon emissions, and therefore should have little impact on global warming and climate change
- The main areas for HEP are central and northern California where rainfall totals are higher (1000mm) and less seasonal (rain falls all year)
- The Sierra Mountains offer heavy rainfall and steep slopes, but dams and reservoirs must be built to help regulate the water supply. This brings secondary benefits as most schemes are multi-purpose
 1. flood control
 2. irrigation water for the central valley farms
 3. water supply for cities such as san Francisco
 4. recreation and tourism
- There is a division between small schemes and large schemes. Larger schemes give more problems and are seen as less sustainable



SOCIAL PROBLEMS

- *displaced population
- *loss of farmland
- *loss of fisheries
- *disease such as malaria in reservoirs
- *impoverishment
- *indigenous people suffer most
- *compensation insufficient

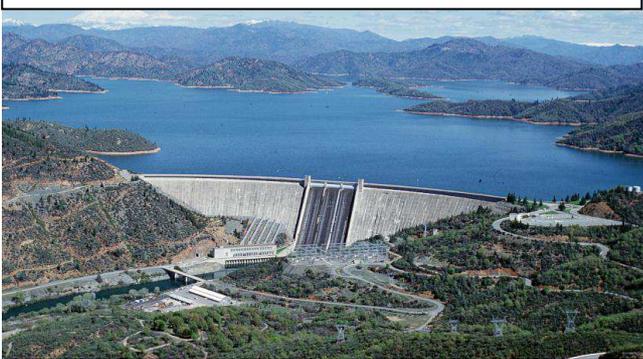
ECONOMIC PROBLEMS

- *large dams and reservoirs are costly
- *many are over-budget
- *many suffer delays and overruns
- *many have lower than predicted outputs
- *sedimentation of reservoirs from upstream input lowers the lifespan of reservoirs

ENVIRONMENTAL PROBLEMS

- *loss of ecosystems
- *loss of species
- *loss of biodiversity
- *more endangered species
- *carbon dioxide from concrete manufacture (global warming)
- *recent research says methane (a GHG) is emitted from reservoirs

Shasta dam Sacramento river Sierra Nevada



RAISING THE SHASTA DAM ?

Yes the dam should be raised

- HEP generation will more than double to produce 1000MW more
- Extra renewable energy will help California reach its sustainability targets
- The larger reservoir will hold more water, giving better flood control and improving water supplies to the growing cities
- The population of California is et to increase by up to 1 million every year so extra energy and water is essential

No the dam should not be raised

- The raising of the dam will flood over 90% of the native Winnemem Wintu tribes sacred, cultural sites; particularly burial grounds and prayer rocks
- Bridges, road, businesses and recreational facilities will have to be relocated
- Raising the dam will flood surrounding canyons and rivers endangering ecosystems, habitats and local flora and fauna. Some species may be lost
- Modification of river flows and reduction in spring runoff may change the erosion and depositional characteristic of the lower river and destroy spawning areas
- Some people argue that other methods of renewable energy production are more sustainable and that conservation programmes for both electricity and water would be more effective
- The impact on migrating salmon may be devastating and the McCloud river trout fisheries may be adversely affected

BIOMASS

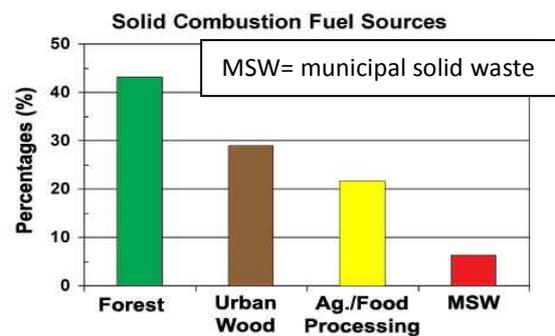
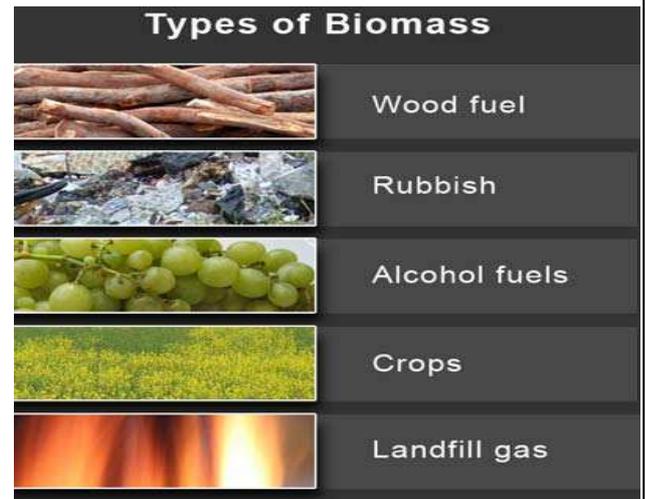
The benefits of using biomass to produce energy are:-

1. The supply of biomass is renewable, meaning it will not run out.
2. Electricity produced by biomass reduces the threat of global climate change.
3. Using biomass waste eliminates the need to place it in landfills.
4. Clearing biomass from wooded areas helps prevent forest fires.
5. Using by-product methane gases to produce electricity eliminates odour and reduces air pollution in surrounding areas.

Biomass is sustainable because :

- It is renewable if crops / woodland is replanted
- Emissions are lower than fossils fuels
- Replanted vegetation captures carbon dioxide
- Ash from the biomass power stations helps vegetation growth

Biomass is particularly important in the thickly wooded areas of northern California



SOLAR POWER

*California aims to increase its use of solar power with the California Solar Initiatives (CSI) which offers grants to companies and individuals to move into solar power production

*Southern California is best for solar power as it receives 2x the sunlight of some areas of the country.

*Desert areas are best due to their low levels of cloudiness.

*Solar power is produced in 3 ways:-

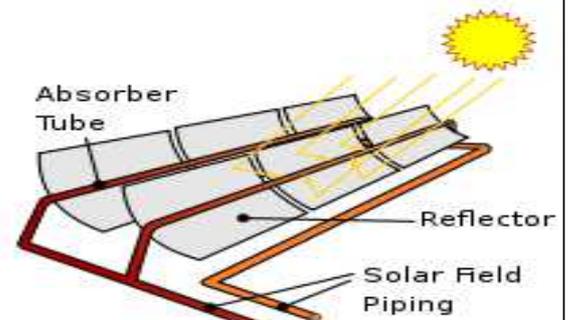
1. A central solar tower with sun tracking mirrors that heats a fluid in the tower to turns turbines
2. Parabolic trough collectors that heat oil to turn turbines
3. Photovoltaic cells (PV) that turn solar energy directly into electricity

Benefits of solar power include :-

- the fact that it uses no fuel and produces no carbon emissions
- It makes both the USA and California less dependent on energy imports gives them more energy security and is useful to top up the grid during peak usage
- The best areas to use are arid and semi arid areas such as the Mojave desert in southern California which have limited use to other human activities
- Microgeneration, on a small and neighbourhood scale, may be the best use of solar power

Drawbacks include :-

- the cost and the fact that very large areas, as much as 5-10 sq. miles, are need for the schemes and this can have a negative impact on the arid and semi-arid habitats, ecosystems, flora and fauna
- The largest scheme in California is the recently opened Mojave Solar Park which produces over 500 megawatts of electricity



GEOTHERMAL

*California sits on a plate boundary between the North American Plate and the Pacific Plate (on the Ring of Fire) which means that hot rocks are closer to the surface and geothermal energy is usable

*California produces the largest amount of geothermal energy in the USA, contributing 5% of its total energy

*The most important area the **Geysers** Geothermal Resource area just north Of San Francisco

The energy is used in 3 ways :-

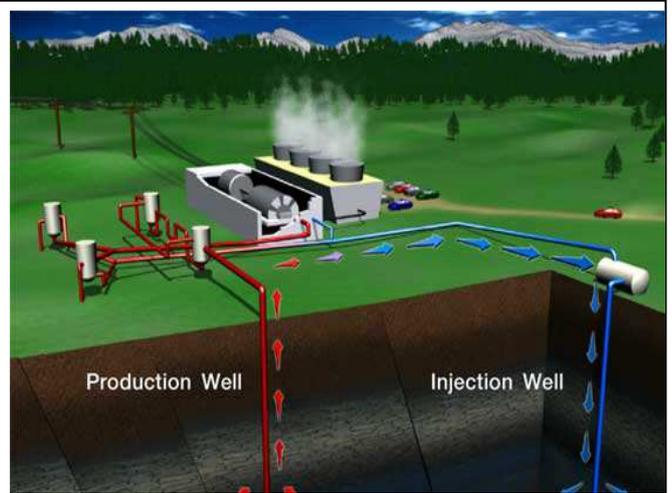
1. Direct use of the heat for space heating and hot water for schools, hospitals, glass houses etc.
2. Dry steam, steam without water, that is used to turn turbines to produce electricity (Geysers)
3. Geothermal reservoirs of hot water that flash to steam and turn turbines

Benefits

- it is non pollution and does not produce climate changing Carbon Dioxide
- It is renewable since it only depends on the earth's internal heat energy and is a continuous 24 hours a day process and is therefore good for the baseload

Drawbacks

- negative visual impacts of the power stations in sometimes attractive areas
- geothermal reservoirs can run dry. If this happens cold water can be injected into the reservoir.
- Geothermal water can also be acidic and corrosive to pipes



WIND POWER

*Wind power is on the increase in California, but still only produces 1-2% of its energy needs

*The two main areas are Palm Springs near Los Angeles and Altamont Pass near San Francisco

Benefits

- Wind power produces no atmospheric pollution and reduces the need for extra conventional fossil fuel powered plants
- It is not affected by fuel prices and, dependent on the wind, offers energy security (no imports needed)
- The modular nature of wind farms means that extra turbines can be added cheaply and easily
- Microgeneration is possible for farms, homes and businesses



Drawbacks

- Although it produces no atmospheric pollution it does have a negative impact on local habitats, ecosystems, flora and fauna, since wind farms need to cover large areas to be efficient
- To be linked to the power grid pylons or underground cables are needed and these also impact on habitats
- They only produce energy when the wind speed is greater than around 10-15 mph and it is still relatively expensive to produce wind energy
- Conservation agencies say that the turbines can kill birds
- Wind farms have a negative visual impact and are said by some to be very noisy
- The flickering caused by turbines and the low frequency sounds and vibrations are said to cause illnesses and the so called wind turbine syndrome

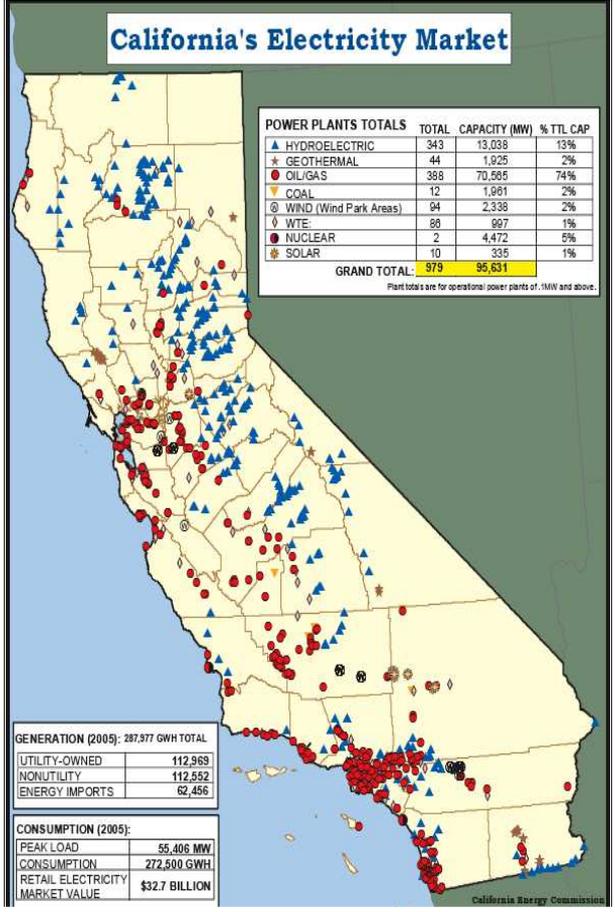
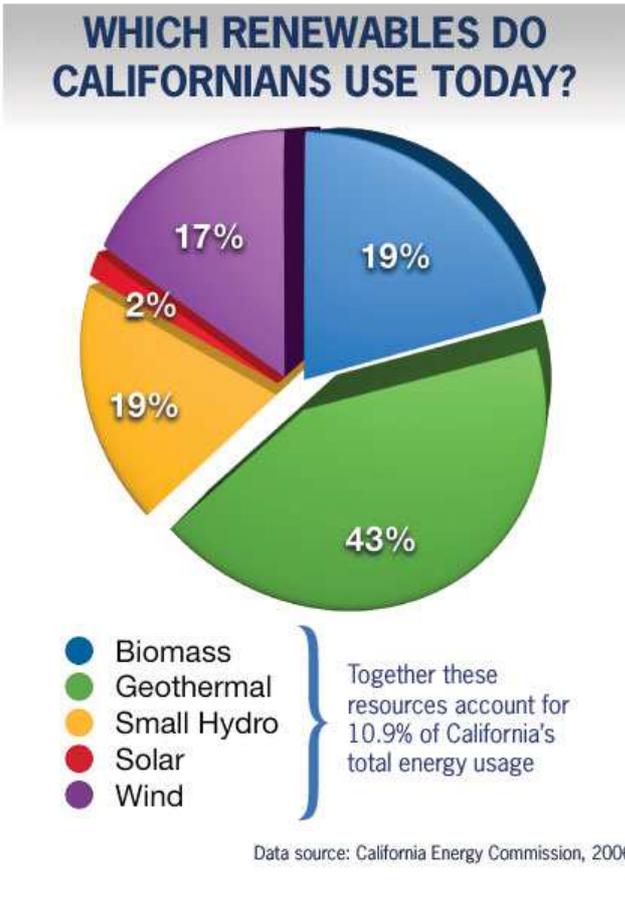
geographyjohn

GEOGRAPHY

CASE STUDY REVISION BOOKLET

CALIFORNIA USA RENEWABLE / SUSTAINABLE / GREEN ENERGY

MANAGING ENERGY SUPPLIES TO ENSURE SUSTAINABILITY



FACTFILE and POLICIES

- *Highest population of any state in the USA
- *If it was a country it would have the 8th largest economy

California has a green agenda for its 37 million residents

- *Aim for 33 % of energy from renewables by 2020
- *Reduce energy consumption through conservation
- *Increase the efficient use of energy
- *Expand the use of renewable resources
- *Cut GHG (greenhouse gas) emissions

