**Topic 7 - ESS answers**

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1. Gas + Oil + Coal
   
   \[ 20.9 + 34.3 + 25.1 = 80.3 \]
   
   80.3%  

2. According to the official population clock:
   
   China: 1,368,040,000
   
   USA: 320,334,000
   
   They have more or less the same energy usage because in USA:
   
   - it is a consumer-based economy – high demand for goods
   - there is more private car ownership
   - more people fly
   - agriculture is mainly commercial with heavy dependence on fossil fuel substitutes
   - more labour-saving devices mean a high demand on electricity
   - higher overall standard of living than China requires more energy.

3. According to the official population clock:
   
   India: 1,266,430,000
   
   - India is a poorer country with limited access to fossil fuels
   - fewer heavy industries than China.

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**Energy consumption**

1. Very low consumption in most of South and central America, Africa and the Far East (LEDC regions of the world).
   
   Very high in North America, Europe and Australia (MEDCs).

2. **Highest consumption [Europe]**  
   - Has numerous luxury items – mobile phones, cars etc.
   - Meat-based diet
   - Many labour-saving devises (washing machine, dishwasher etc.
   - Drives most of the time
   - Flies to holiday destinations
   - Has leisure time

   **Lowest consumption [Africa]**  
   - Has very few or none of these items
   - More vegetarian diet
   - Washes clothes and dishes in the local waterways
   - Walks/cycles/rides animals
   - Does not have holidays
   - No or little leisure time

3. Increased affluence has allowed more people to have air conditioning.
   
   Climate change is pushing the temperature higher and the need for air conditioning is greater.
   
   Higher incomes with economic growth so more spending power so more luxuries bought, many of which use energy – fridges, cars.

4. Increase in price of crude oil cut consumption.
   
   Financial markets crashed.
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- CO₂ is consistently an important GHG but it has not risen as much proportionally as methane.
- Methane has more than doubled in amount.
- Nitrous oxide has increased but not by as much.

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<table>
<thead>
<tr>
<th>Greenhouse gas</th>
<th>Sources due to human activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td>Combustion of fossil fuels</td>
</tr>
<tr>
<td></td>
<td>Deforestation/loss of vegetation to lock up carbon</td>
</tr>
<tr>
<td>Methane</td>
<td>Rice paddies</td>
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<tr>
<td></td>
<td>Cattle farming</td>
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<td></td>
<td>Waste tips</td>
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<td>Ocean warming</td>
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<tr>
<td>Ozone</td>
<td>Combustion of fossil fuels</td>
</tr>
<tr>
<td>Nitrous oxide</td>
<td>Combustion of fossil fuels</td>
</tr>
<tr>
<td></td>
<td>Agriculture</td>
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<td></td>
<td>Internal combustion engine</td>
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<tr>
<td></td>
<td>Industrial pollution</td>
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<tr>
<td>CFCs</td>
<td>Aerosols</td>
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<td></td>
<td>Gas-blown plastics</td>
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<td></td>
<td>Flame retardants</td>
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<td></td>
<td>Pesticides</td>
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<td></td>
<td>Refrigerants</td>
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</tbody>
</table>

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1. There appears to be a direct link between changes in the atmospheric CO₂ (ppm) and the changes in atmospheric temperatures (°C).

2. • There is a steady overall increase in CO₂ levels but with regular seasonal fluctuations.
   • Human activities are burning fossil fuels where carbon was locked up (carbon sinks) and this releases carbon dioxide to the atmosphere

3. • 1960 – 317 ppm
   • 2008 – 380 ppm
   • That is an increase of 63 ppm
   \[
   \frac{63}{317} \times 100 = 19.9\% \text{ increase}
   \]

4. • The majority of the landmass is in the northern hemisphere where winter is around November–February.
   • Photosynthesis rates peak in spring and summer – that removes CO₂ from the atmosphere and so levels go down.
   • Photosynthesis is minimal in the winter, less CO₂ is removed so levels peak then.

5. An overall increase.

6. In both years, averages before were falling for about 10 years so would have said average temperature of Earth had been rising but was now falling.

7. An overall increase, but like air temperatures – fluctuating.
8. Pinatubo erupted in 1991; at that time global temperatures showed a marked spike. This may be due to:

- Pinatubo injected large amounts of lava and ash into the stratosphere – this acted like a blanket trapping heat in the atmosphere – the aerosol particles absorb radiation.
- Then sea surface temperature fell which could be due to volcanic dust in the atmosphere stopping solar radiation reaching the Earth’s surface and warming it – dust could reflect radiation back to space.

In El Niño years, this is the warm phase of the Southern Oscillation so generally speaking global temperatures are higher. This is due to the fact that the upwelling of cold water off the coast of Peru is inhibited and so ocean surface temperatures stay higher.

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<table>
<thead>
<tr>
<th>Advantages of climate change</th>
<th>Disadvantages of climate change</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Northwest Passage will improve shipping</td>
<td>Africa will lose food production</td>
</tr>
<tr>
<td>Warmer winters mean less human deaths related to the cold</td>
<td>Corals are very sensitive to changing sea temperatures — die</td>
</tr>
<tr>
<td>Rate of photosynthesis should increase therefore so will NPP</td>
<td>Could cause environmental refugees – move away from areas that can no longer support them</td>
</tr>
<tr>
<td>HEP generation at higher altitudes if rivers no longer freeze</td>
<td>Extinction of plant and animal species</td>
</tr>
<tr>
<td>European growing season may expand but other areas will lose out</td>
<td>Heat waves kill livestock and people</td>
</tr>
<tr>
<td>Fewer snow storms and fewer deaths on the road</td>
<td>Insect disease vectors will spread — malaria, dengue fever and yellow fever could spread to Europe</td>
</tr>
<tr>
<td>May open up new mineral reserves in some areas — e.g. tar sands in Siberia</td>
<td>Loss of glaciers is causing drought in many areas as the summer melt no longer feeds rivers and ground water, e.g. Ganges, Brahmaputra, Indus, Yellow, Yangtze and Tanzania around Kilimanjaro</td>
</tr>
<tr>
<td>Reduced heating bills</td>
<td>Increases evaporation causes lakes and rivers to dry up</td>
</tr>
<tr>
<td>Melting ice could make for easier exploitation of undersea minerals and fossil fuels in polar regions</td>
<td>More dry weather = more irrigation and more salinization</td>
</tr>
<tr>
<td>May slow down the North Atlantic Drift current making UK and Scandinavia much colder</td>
<td>Melting permafrost causes subsidence and collapse of buildings</td>
</tr>
<tr>
<td>Melting permafrost releases methane = positive feedback mechanism</td>
<td>Methane clathrate is a form of ice under the Arctic Ocean floor that traps methane. If this were to melt and reach the surface, the release of methane may trigger a rapid increase in temperature</td>
</tr>
<tr>
<td>More extreme weather events — Hurricane Katrina</td>
<td>More severe weather, more rainfall = more soil erosion</td>
</tr>
<tr>
<td>Pests no longer killed off by cold winters</td>
<td>Sea levels rise — low lying states will lose land, e.g. Bangladesh, the Maldives and the Netherlands</td>
</tr>
<tr>
<td>Toxic algal blooms increase — can kill humans</td>
<td>Warmer seas will reduce productivity of marine areas</td>
</tr>
<tr>
<td>Water supplies will decrease</td>
<td>Wildfires may increase as drought increases</td>
</tr>
<tr>
<td>More drier climates = more fungal diseases</td>
<td>Drier climates = more asthma and chest infections</td>
</tr>
<tr>
<td>Wildfires may increase as drought increases</td>
<td></td>
</tr>
</tbody>
</table>
CLOUDS

Positive feedback
- Global warming
- More evaporation
- More clouds
- Trap more heat

Negative feedback
- Global warming
- More evaporation
- More clouds
- Reflect more heat
- Stop global warming

Negative feedback in oceans
- Global warming
- Oceans warmer
- Phytoplankton photosynthesize faster
- Absorb more CO₂
- More phytoplankton produced
- More CO₂ absorbed
- Dampens global warming

Quick review questions

1. B
2. A
3. C
4. D
5. C
6. D
7. D
8. D
9. B