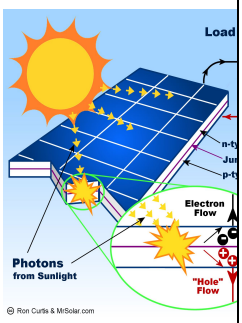
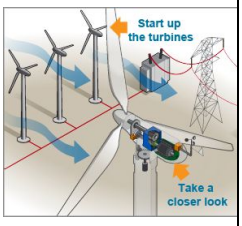
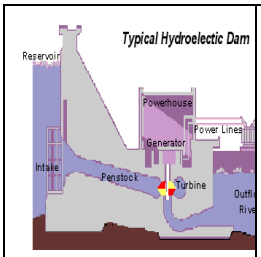
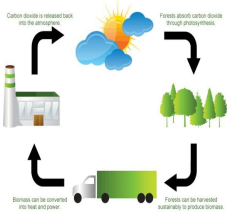
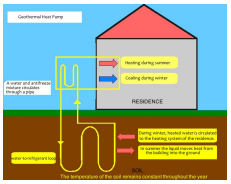
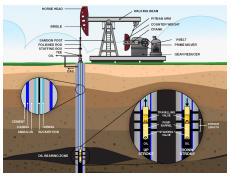
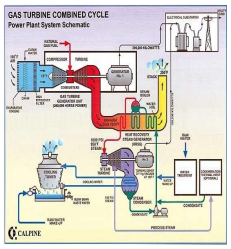
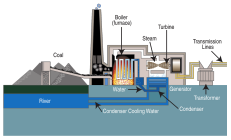
Energy Justification Document - 6th/7th period, 2018

Energy Source	How does it work?	Pros	Cons
Solar Power 	A solar panel works by allowing photons, or particles of light, to knock electrons free from atoms, generating a flow of electricity. Solar panels actually comprise many, smaller units called photovoltaic cells. Metal conductive plates on the sides of the cell collect the electrons and transfer them to wires. At that point, the electrons can flow like any other source of electricity.	• Clean alternative to fossil fuels • Free after installation besides maintenance • Unlimited energy as long as sun exists • Available to all corners of the globe • Becoming cheaper by the day	• Only generated while sun shines • Expensive building cost • Amount of space it takes up • Rare materials for production
Wind Power 	Wind turbines convert the kinetic energy in the wind into mechanical power.This is done by using a large wind turbine usually consisting of propellers; the turbine can be connected to a generator to generate electricity, or the wind used as mechanical power to perform tasks such as pumping water or grinding grain. As the wind passes the turbines it moves the blades, which spins the shaft.	• Good for the environment • Renewable • Cost effective • Profit for landowners • Use of modern technology • Huge potential/ growth rates • Low costs • Abundant domestic supply • Power is free • Can be used almost anywhere	• Deadly/harmful to birds • Wind is unpredictable and cannot be controlled • Not cheap like other energy sources • Take the beauty out of the landscape • Turbines can be quite loud • Impact on local weather and temperatures
Hydro Power	"Hydropower plants capture the energy of falling water to generate electricity. A turbine converts the kinetic	-The most used renewable energy source in the world	-Environmental consequences -Expensive Initial Cost

	energy of falling water into mechanical energy. Then a generator converts the mechanical energy from the turbine into electrical energy." -Wisconsin Valley Improvement Company	-Reliable -Safe - Low cost of maintenance and operation - Can last 50-100 years, due to the fact that they are built for long-term use -Can help remote areas grow economically Recreation	-May lead to Droughts -Limited Reservoirs -Carbon dioxide and methane emission - Risk of floods and relocation due to strong water currents released from the dam -Ecosystem damage due to interruptions of natural water flow, and draining of water - Risk of dam failure due to high levels of water, natural disasters, or construction errors Disrupts recreation
Biomass/Biofuel Group 2 	"Biofuels are combustive fuels made from recently harvested plants. They work much like fossil fuels: they burn when ignited, releasing energy that can be converted to motion in a car, or heat for a house. Biofuel can be sourced from a number of different crops, as well as excess plant matter from other industries." Heat boils water to create steam, steam and heat rises pushing on a turbine, creating a current and electricity.	• Bio-based fuel with essentially carbon neutral combustion • Drop in replacement for petroleum-based liquid fuels • Inherently renewable • Absorbs carbon dioxide as it grows • Both waste CO2 and wastewater can be used as nutrients • Higher energy per-acre than other biofuels	• Need to be grown under controlled temperature conditions • Requires a considerable amount of land and water • Cold flow issues with algal biofuel • Fertilizer production is carbon dependent • Relatively high upfront capital costs • Not clear yet what the ultimate cost per gallon will be. Presently too high. Link=https://www.triplepundit.com/special/energy-options-pros-and-cons/algae-based-biofuel-pros-cons/

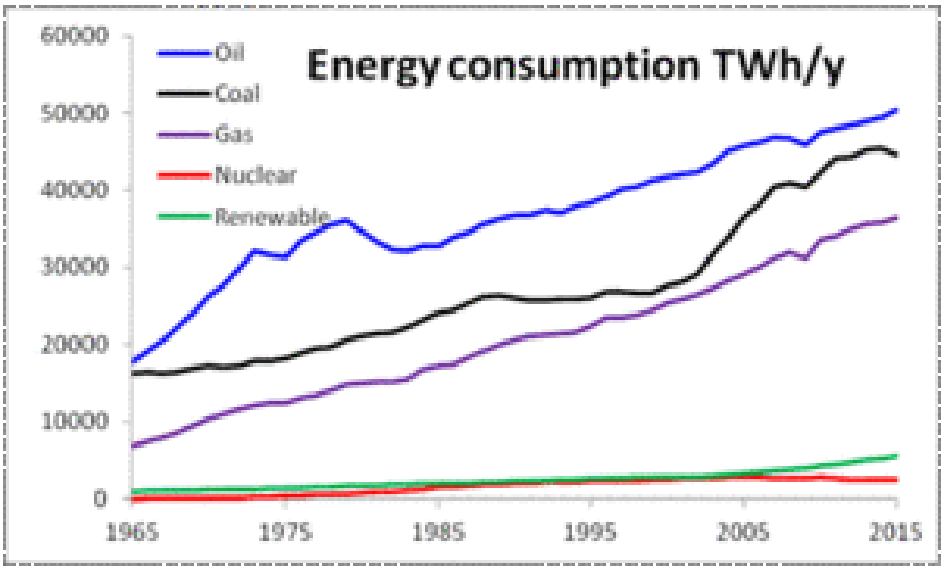
Geothermal Energy Group 3 	Geothermal energy is the heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma. Heat boils water to create steam, steam and heat rises pushing on a turbine, creating a current and electricity.	• Energy efficient • Earth-friendly • Renewable • Takes up less space, partially underground • Reliable • Free after upfront payment	• Bad for earthquakes • Expensive upfront prices • **Needs a certain location** • If not properly managed, the reservoirs can break down
Oil/Petroleum (fossil fuel) Group 3 	Oil sits underground in reservoirs, and is burned to create energy. There are three main ways that it is converted into energy. Conventional steam - Oil is burned to heat water to create steam to generate electricity. Combustion turbine - Oil is burned under pressure to produce gases which spin a turbine to generate electricity. Combined-cycle technology - a combination of the first two	• it is easy to extract • Has a high density • Can be extracted at a low cost • Easily transported • Can power up almost all types of vehicles • Crucial element in industries • Broad areas for application • Support constant power use • It is powerful source of energy	• Limited resource • Pollution • Non-renewable • Can cause oil spills • Internationally found (can cause conflict)

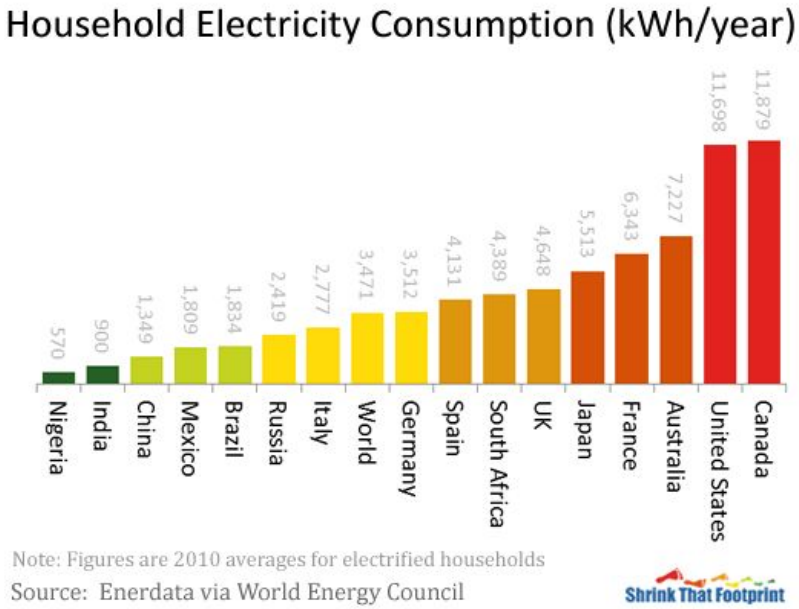
Natural Gas (fossil fuel)  	Natural gas is burned in a boiler in order to heat water and produce steam which is used to turn a turbine and generate electricity https://www.google.com/search?safe=strict&rlz=1CADEAC_enUS784&ei=q2eDWoyyOtKGjwOn36joDA&q=how+does+natural+gas+make+energy hq=how+does+natural+gas+make+energy&gs_l=psy-ab.3..0j0i22i30k1.1203.5909.0.6269.21.17.2.0.0.0.275.1948.8j8j1.17.0....0...1c.1.64.psy-ab..2.19.1966...0i67k1j33i22i29i30k1.0.iDjGphAVDnA	• Produces less pollution than other gaseous forms • Cheap • Easy to Transport • Found in US	• Highly flammable • Greenhouse gas • Non-renewable resource • Leaks have huge consequences • Fracking (hydraulic fracturing) https://www.yaleclimateconnections.org/2016/07/pros-and-cons-the-promise-and-pitfalls-of-natural-gas/
Coal (fossil fuel)  	In a coal-fired steam station, the steps are that heat is created, the water is turned into steam, the steam turns into turbine generators which produces electricity. tps://www.duke-energy.com/energy ducation/how...works/electricity-fro oal	• Most widely fueled in power plants • Affordable • Easy to burn • Reliable energy source tps://sunglitz.wordpress.com /advantages-and-disadvanta -of-using-coal-energy/	• Non-renewable • Damages environment around coal mines • High cost transportation • Releases a lot of carbon dioxide into the atmosphere https://www.triplepundit.com/special/energy-options-pros-and-cons/clean-coal-pros-cons/
Nuclear power/ Uranium	Nuclear power plants obtain the heat needed to produce steam through a physical process. This process, called fission, entails the splitting of atoms of uranium in a nuclear reactor. The uranium fuel consists of small, hard ceramic pellets that are packaged into long, vertical tubes. Bundles of this fuel are inserted into the reactor. This steam is used to spin a turbine	• Clean Energy Source • Energy Efficient • Low cost to run • More proficient than other energy sources	• Nuclear Waste • People can be affected in the event of a meltdown or plant failure • Limited uranium resources • Japan Crisis • High cost to create • Non- renewable

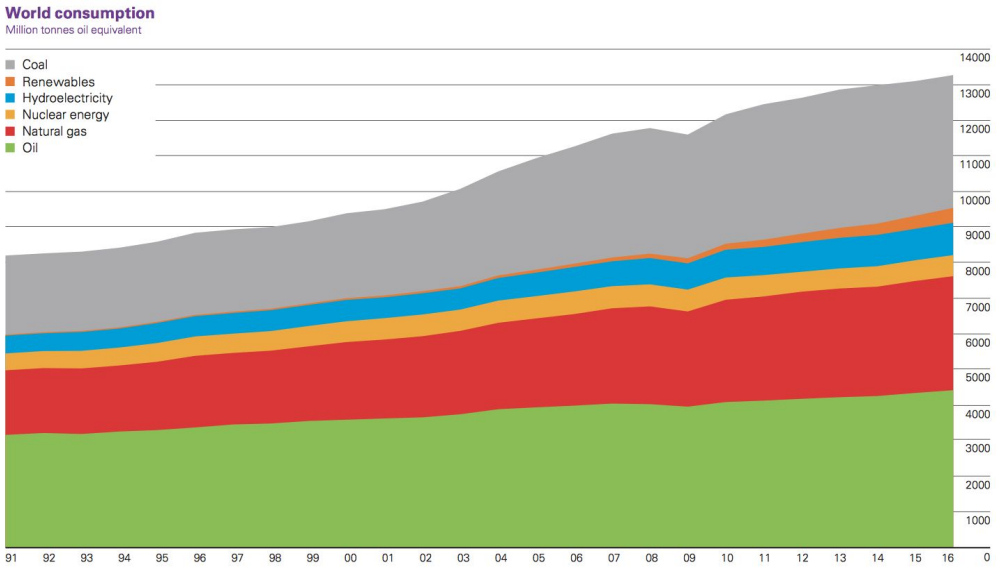
	which uses motion to create energy.		

Why build a house without electricity?

1. How much energy do humans use? In what





forms? 

- In Marin County 75% of its energy comes from renewable sources(solar,wind,hydroelectric,geothermal)
- Much higher than CA goal to get to 33% by 2020
- Global electricity consumption average can be as high as 3,500 kWh/year.
- household size and electrification rates are the reasons China and India are so low.
- Oil is still the most used source of energy, however, coal and natural gases are being used more. That being said, the amount of nuclear and renewable energy has remained relatively low.
- https://www.bp.com/content/dam/bp/en/corporate/pdf/energy-economics/statistical-review-2017/bp-statistical-review-of-world-energy-2017-full-report.pdf
- http://shrinkthatfootprint.com/average-household-electricity-consumption
- https://venturebeat.com/2010/08/03/how-marin-county-gets-75-percent-of-its-power-from-renewables/

2. Cost/Economics of electricity: How much money is spent on electricity generation? In different parts of the country? In other countries?

The amount of electricity generation varies by country due to many different factors. Using this graph provided by wikipedia, we can analyze this to determine the amount of energy generated by different countries. This graph organizes the data based on Gigawatt hours. To convert the Gigawatt hours to dollars, the average cost per kilowatt hour is 20 cents, taken from the average per country.

The average spent on electricity per person in hawaii is 32.2 cents per kilowatt hour. Idaho only spends 8 cents per kilowatt hour.

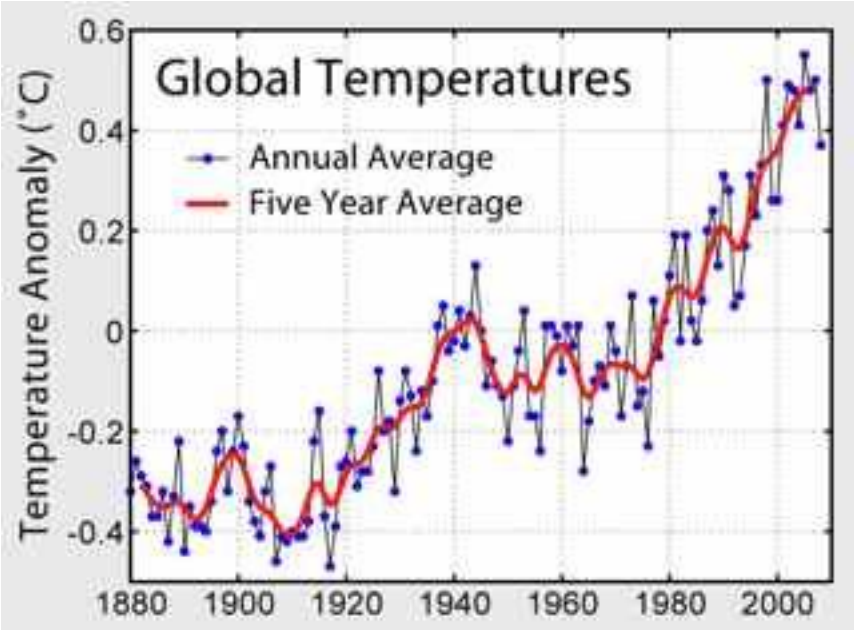
Americans spend 3020$ per year on electricity

State	Average Rate: November 2017	Average Rate: November 2016	% up/down	% of U.S. avg.	Rank
Alabama	12.54	12.24	2.5%	92%	29
Alaska	21.90	20.90	4.8%	161%	50
Arizona	12.26	11.60	5.7%	90%	30
Arkansas	10.28	10.11	1.7%	76%	5
California	18.77	17.93	4.7%	138%	45
Colorado	12.02	12.27	2.0%	88%	22
Connecticut	20.70	19.76	4.8%	152%	49
DC	14.00	12.93	7.0%	103%	37
Delaware	13.81	13.83	0.1%	101%	36
Florida	12.47	11.08	12.5%	92%	26
Georgia	10.99	11.00	0.1%	81%	13
Hawaii	30.58	28.48	7.4%	225%	51
Idaho	10.08	10.02	0.6%	74%	4
Illinois	13.47	13.14	2.5%	99%	35
Indiana	12.38	12.83	3.5%	91%	25
Iowa	12.03	11.63	3.4%	88%	23
Kansas	13.37	13.29	0.6%	98%	34
Kentucky	10.97	11.23	2.3%	81%	12
Louisiana	9.29	9.38	1.0%	68%	1
Maine	16.05	16.21	1.0%	118%	42
Maryland	13.35	14.31	6.7%	98%	33
Massachusetts	19.36	19.14	1.1%	142%	46
Michigan	15.24	15.37	0.8%	112%	40

Minnesota	12.92	13.07	1.1%	95%	32
Mississippi	11.44	10.96	4.4%	84%	18
Missouri	10.46	11.14	6.1%	77%	6
Montana	11.05	10.95	0.9%	81%	15
Nebraska	10.53	10.7	1.6%	77%	8
Nevada	12.89	11.79	9.3%	95%	31
New Hampshire	19.88	19.05	4.4%	146%	47
New Jersey	15.34	15.26	0.5%	113%	41
New Mexico	12.48	11.98	4.2%	92%	27
New York	17.81	17.73	0.5%	131%	43
North Carolina	11.02	11.11	0.8%	81%	14
North Dakota	9.69	10.26	5.6%	71%	2
Ohio	12.49	12.42	0.6%	92%	28
Oklahoma	10.76	9.54	12.8%	79%	10
Oregon	10.70	10.76	0.6%	79%	9
Pennsylvania	14.50	14.14	2.5%	107%	39
Rhode Island	20.48	18.14	12.9%	150%	48
South Carolina	12.70	12.75	0.4%	93%	30
South Dakota	11.60	11.74	1.2%	85%	19
Tennessee	10.87	11.05	1.6%	80%	11
Texas	11.40	11.10	2.7%	84%	17
Utah	10.52	10.67	1.4%	77%	7
Vermont	17.87	17.88	0.1%	131%	44
Virginia	11.67	11.45	1.9%	86%	20
Washington	9.73	9.60	1.4%	71%	3
West Virginia	11.67	11.73	0.5%	86%	20

Wisconsin	14.47	14.07	2.8%	106%	38
Wyoming	11.16	11.26	0.9%	82%	16

3. Climate change - how does it happen?(greenhouse effect, carbon cycle, use of sun's energy):

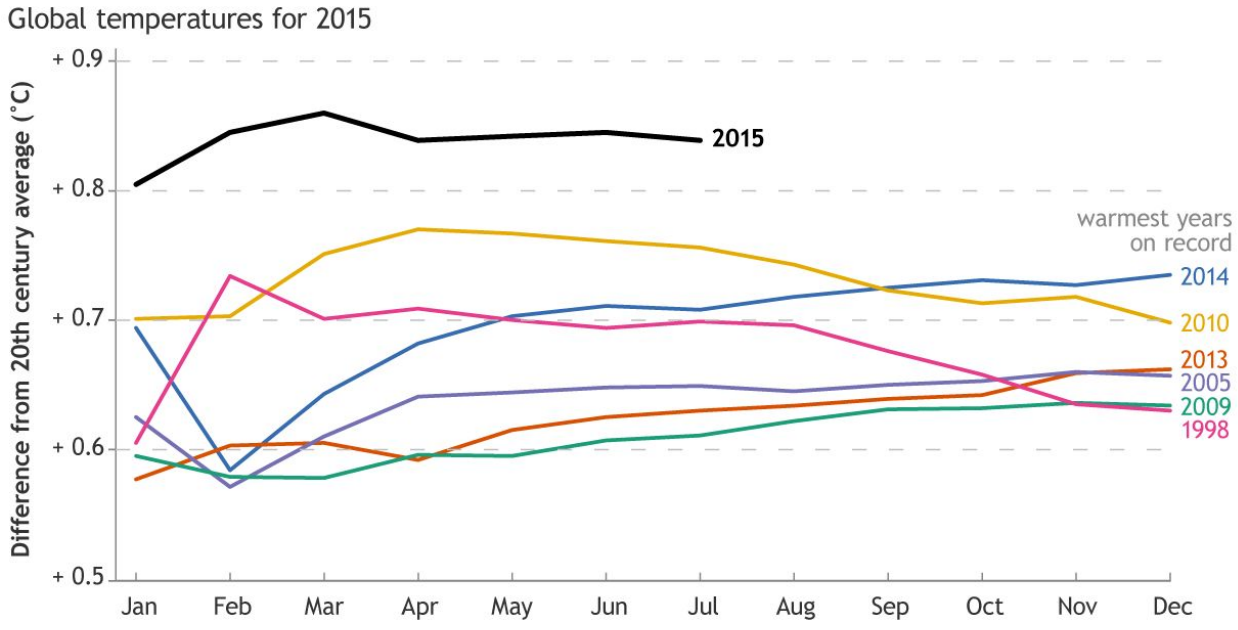


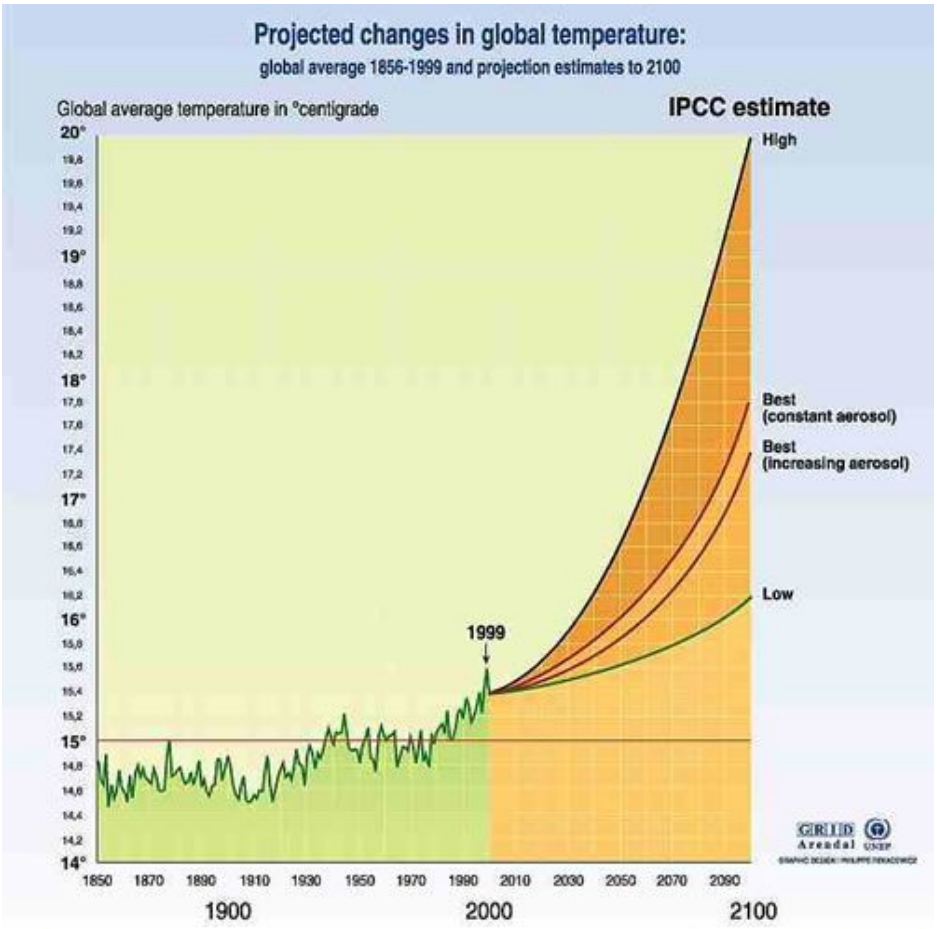
Climate change is a real problem that if not addressed can lead to the declination of our planet. A conclusion from scientific investigations of the causes of climate change show over 95% of the experiments showed the high probability that humans' actions over the past 50 years have influenced climate change(Nasa). These actions include aren't limited industrial smoke stacks, nuclear waste, and green gas emissions. A NASA informational article stated the fact, "The panel also concluded there's a better than 95 percent probability that human-produced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused much of the observed increase in Earth's temperatures over the past 50 years." Some greenhouse gases include methane and carbon dioxide. They help retain the heat of the planet. The gases absorb heat from the earth surface and hold it in with the greenhouse effect. Climate change is when there is an unnatural balance of gases in the atmosphere. They can affect the climate of the earth. Climate change is caused when there are changes in average conditions over many years. How climate change works is humans release gases into the atmosphere by burning fossil fuels or other activities. This creates and unbalanced amount of greenhouse gases in the atmosphere and it will affect the climate.

4. Climate Change - Consequences - what could happen as a result of the changing climate?

Many things have already happened because of climate change. The icy glaciers have shrunk in size, the ice over the ocean and lakes is breaking up earlier and earlier, the lifestyles and habitats of countless animals and plants have changed, and the trees are all coming into bloom earlier. The effects of climate change are likely to be quite significant, and will definitely get worse over time. Some of these effects will probably include a temperature increase of about 2.5 - 10 degrees Fahrenheit over a century, which will impact different regions in different ways, some in good ways, but most in bad ways, in total, increasing the net cost of annual living. Another effect will be the increase of a "frost-free" period, or time without snow, due to the increase of heat-trapping gas emissions. Places of low elevation may be in danger due to rising sea levels from the melting solar caps, by 2100, it is projected that the sea level will increase by 1-4 feet. Heavy rainfall events will increase in number as well, however the time between them will increase over time.

https://climate.nasa.gov/effects/





Actual global temperatures are plotted on the graph for years 1856-1999 and IPCC estimates of temperature are plotted for years 1999-2100. Different lines on the graph between 1999 and 2100 indicate high, low, and best estimates of future temperature.

Courtesy GRIDA/UNEP