

Global Climate Change and China

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National Central University, Taiwan, ROC, 11/15/2017

Climate does Change ! Just like Seasons !!

Spring

Summer

Fall

Winter

http://all-free-download.com/free-photos/download/the_four_seasons_209357.html

Is Our Beautiful Earth Getting Sick?

Earth Polychromatic Imaging Camera (EPIC)

<http://epic.gsfc.nasa.gov/>

It seems that we are experiencing more natural disasters!

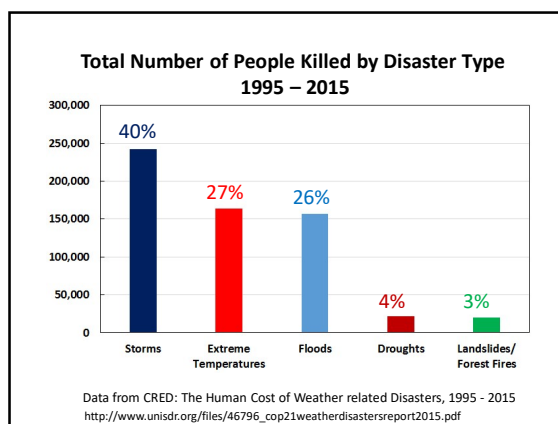
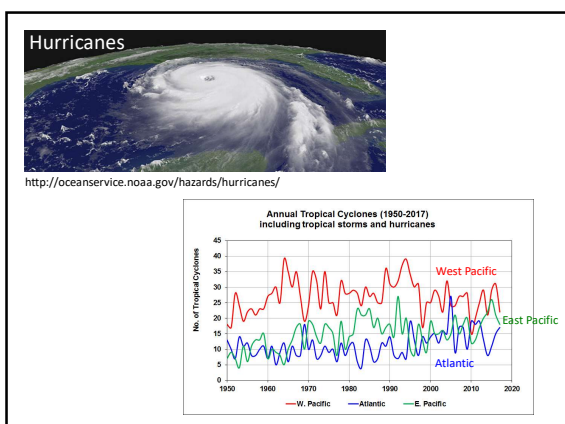
Forest Fire

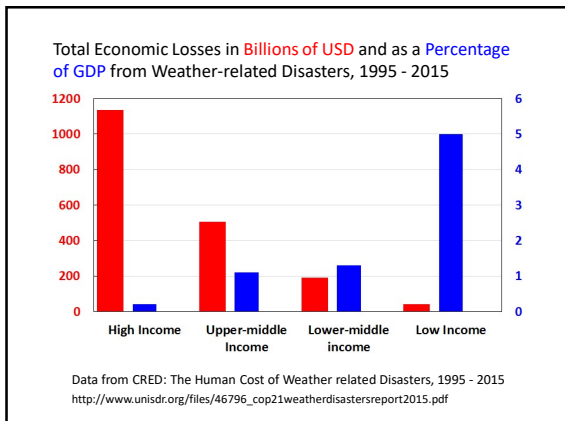
Drought

Extreme Temperatures

Flooding

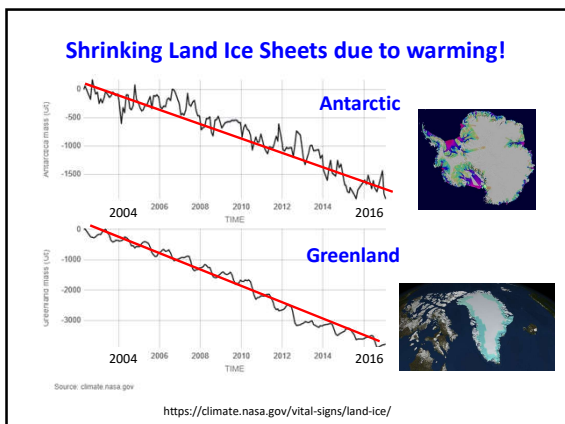
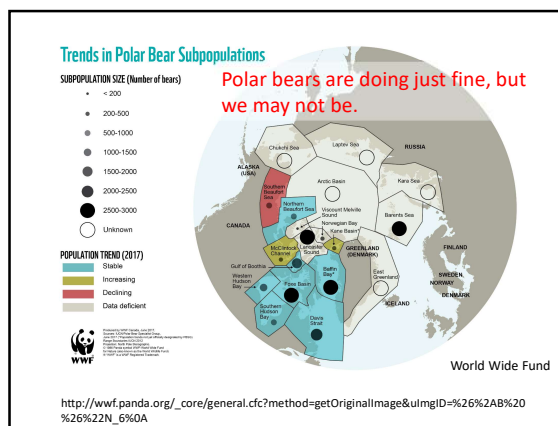
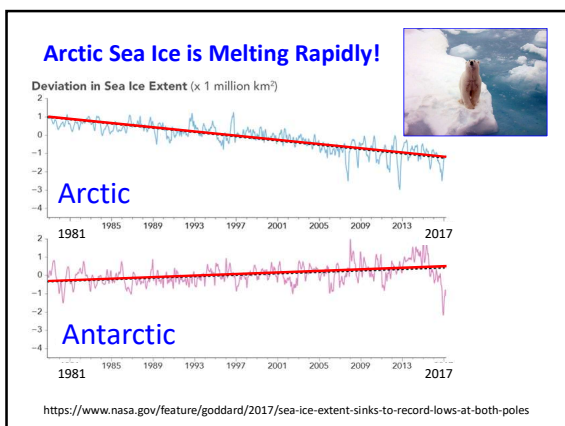
http://www.noaa.gov/features/04_resources/fire2.html
http://www.noaa.gov/features/monitoring_0209/images/drought.jpg
<http://www.nesdis.noaa.gov/fourbox/04-29-13/>





Outline

- Evidences of Climate Change
- Causes for Climate Change
- Carbon Dioxide and Climate Change
- China's Role in Climate Change
- Impacts of Climate Change
- Actions on Climate Change
- Future Climate and Global Economy

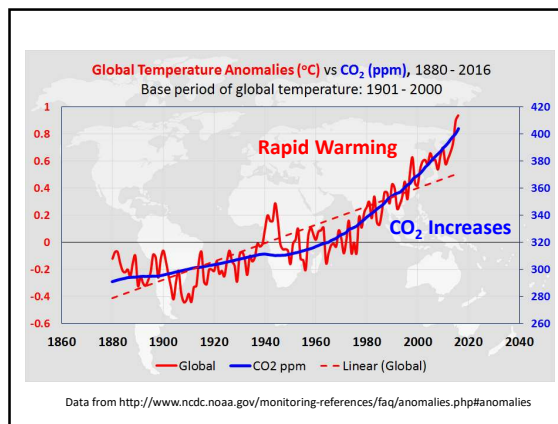
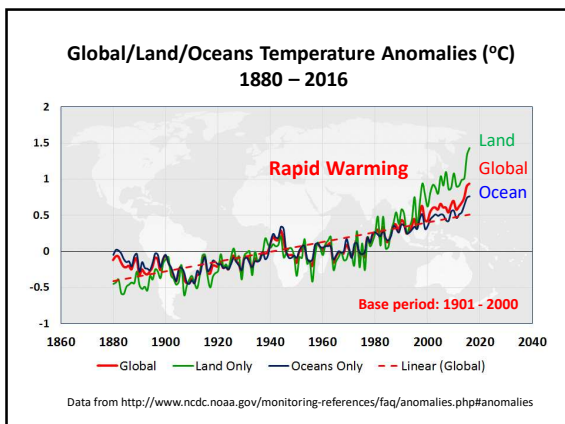
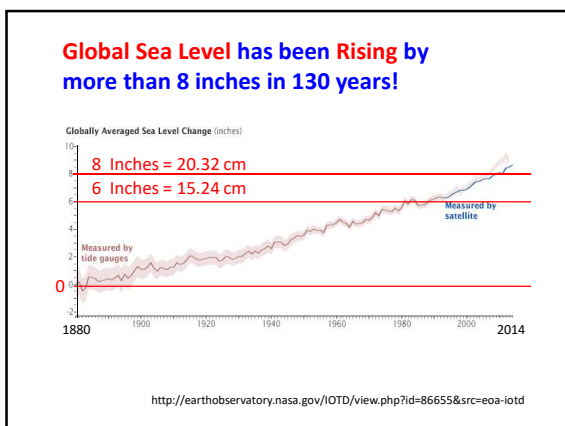
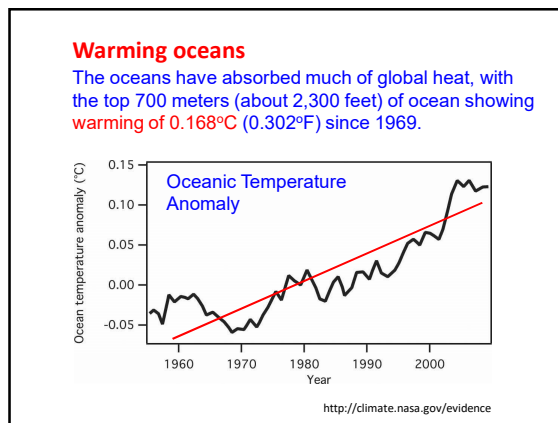
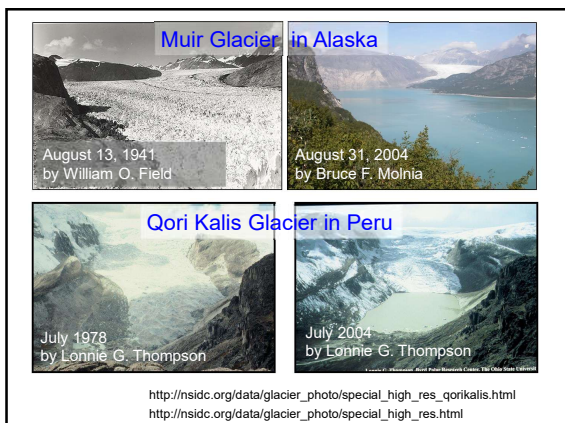


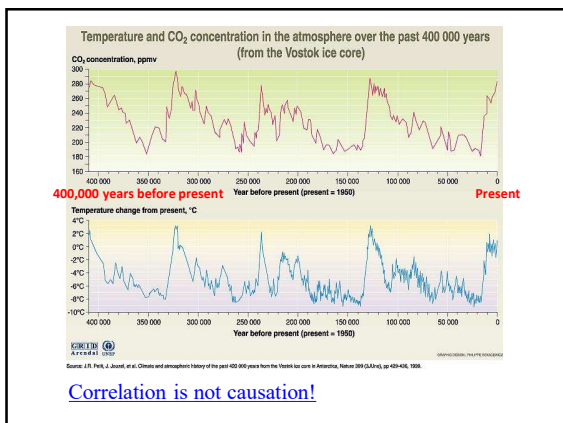
Glaciers are retreating!

The disappearing snowcap of Mount Kilimanjaro, Tanzania.

1993 2000

http://nsidc.org/cryosphere/sotc/glacier_balance.html
<https://climate.nasa.gov/interactives/global-ice-viewer/#/1/16>





Atmospheric Greenhouse Effect

Sunlight passes the atmosphere and warms the earth's surface. Earth's surface then radiates the longwave radiation back to space. Most of the outgoing longwave radiation from the earth's surface is absorbed by the greenhouse gases and re-emitted in all directions, warming the surface of the earth and the lower atmosphere.

Greenhouse Gases

Water vapor (H₂O) Nitrogen oxide (N₂O) Carbon dioxide (CO₂) Methane (CH₄)

Venus Too much greenhouse effect T = 462°C

Mars No greenhouse effect T = -60°C

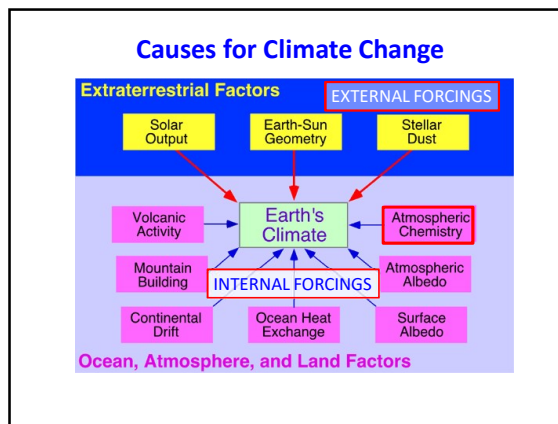
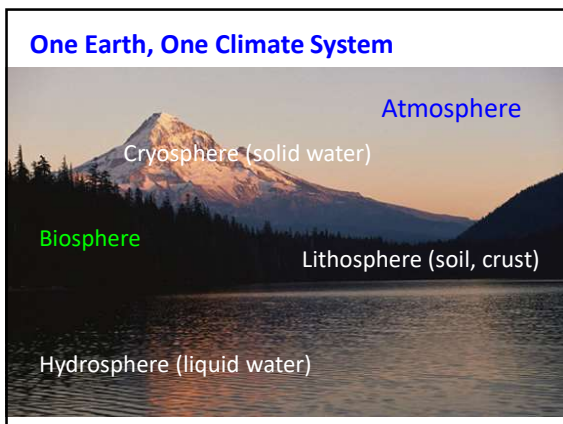
<http://climate.nasa.gov/causes/>

Our Earth is at the **right** distance from the sun, and it has the **right** composition of gases in the atmosphere to provide us with the **right** amount of greenhouse effect, so that we can survive comfortably at **15°C!**

Thanks! Atmospheric Greenhouse Effect

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Earth and Sun Geometry

Eccentricity
(100,000-year cycle)

Obliquity
(44,000-year cycle)

Precession
(22,000-year cycle)

Milankovitch Cycles of variations in earth's orbit (proposed in 1920)

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The Sun

Solar Output

Corona
Chromosphere (atmosphere)
Photosphere (surface)
Prominence (solar storm)

D: 1,390,000 km
Mass: 1.989×10^{30} kg
T: 5,800 K (surface)
15,600,000 K (core)

A gaseous body:
74% Hydrogen
24% Helium

Sunspot Cycle of 11 years

Monthly Averaged Sunspot Numbers (V2.0)

More sunspots indicate stronger solar activities and solar winds/storms!

23
24

Next Solar Max.: March 2001 Next Solar Min.: January 2000

https://solarscience.msfc.nasa.gov/images/Zurich_Color_Small.jpg

Internal Forcings

- Continental drift/polar wandering
- Topography/mountain building/sea floor spreading
- Land and sea distribution
- Volcanic eruptions
- Variations of atmospheric compositions
- Snow and ice cover

Plate Tectonics/Continental Drift

Internal Forcings

PERMIAN 225 million years ago
TRIASSIC 200 million years ago
JURASSIC 135 million years ago
CRETACEOUS 65 million years ago
PRESENT DAY

Plate Tectonics/Continental Drift

Internal Forcings

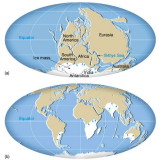

100 Ma into the Future

Australia

The geography of the earth in 100 million years from now!

Internal Forcings

- Continental drift/polar wandering
- Topography/mountain building/sea floor spreading
- Land and sea distribution
- Volcanic eruptions !!! (Cooling the earth!)
- Variations of atmospheric compositions !!!
- Snow and ice cover !!!

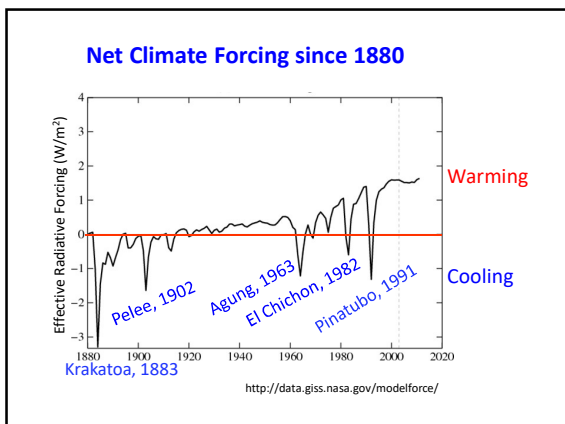
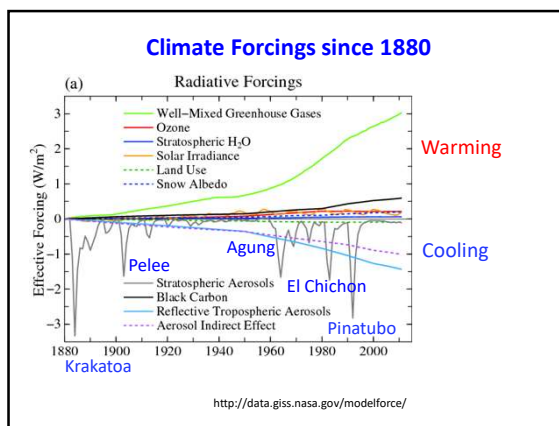
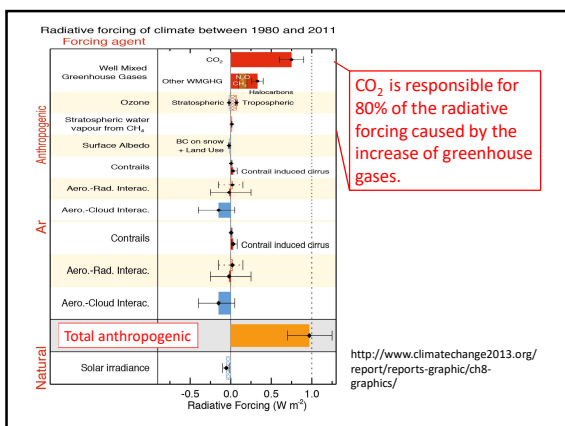



How to determine Climate Forcings?

Represent them in W/m^2 , therefore they are called "radiative forcings".

Radiative forcing is a direct measure of the amount that the Earth's energy budget is out of balance, thereby contributing to climate change.

<https://pixabay.com/en/sunset-sun-abendstimmung-1626515/>

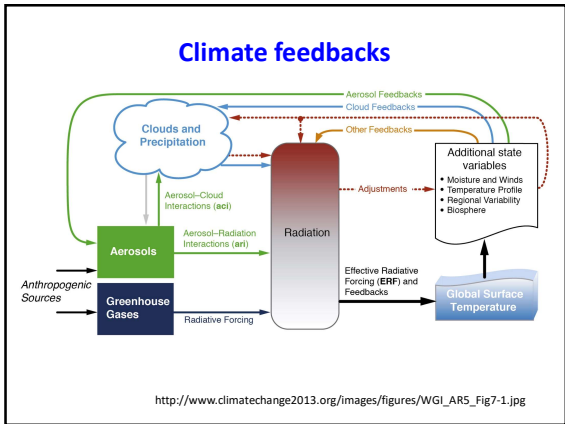


How about Climate Feedback Mechanisms?

Climate feedbacks are processes that change as a result of a change in forcing, and cause additional climate change.

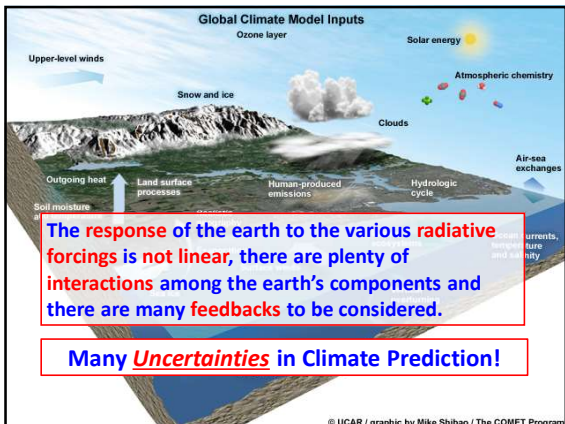
The **positive feedback** amplifies the initial change; while the **negative feedback** reduces it.

Climate Feedback is a cause-effect cycle that may amplify (positive feedback) or dampen (negative feedback) the initial change after the cycle is completed.



In short, climate changes are due to

- External and Internal Natural **Forcings**
- Interactions and **Feedbacks**
- The **increased concentration of carbon dioxide** may partially contribute to the **global warming** since 1950's, and it has therefore caused the global climate to change.
- Most carbon dioxide emission comes from the **burning of fossil fuel** (coal, oil, natural gas) for energy use.

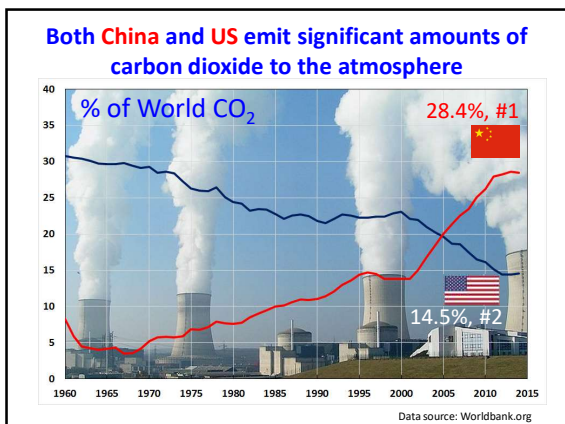
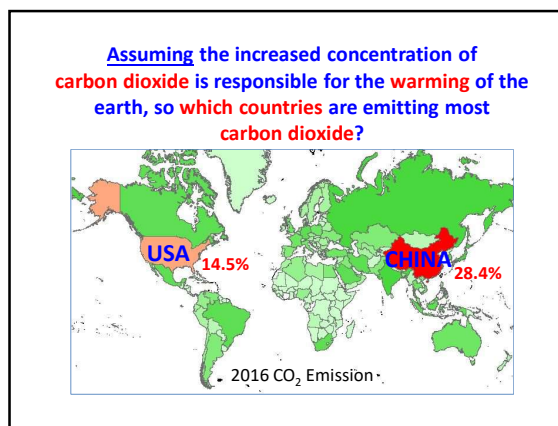
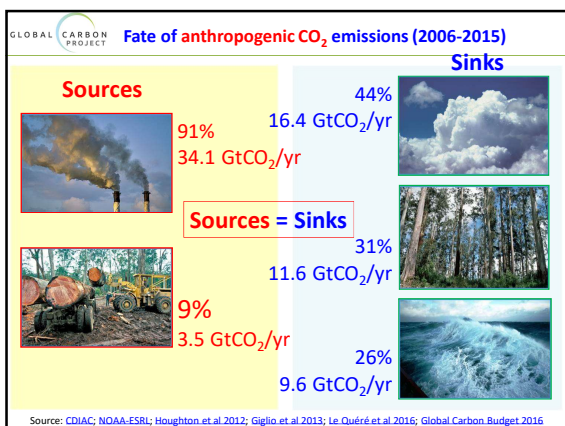
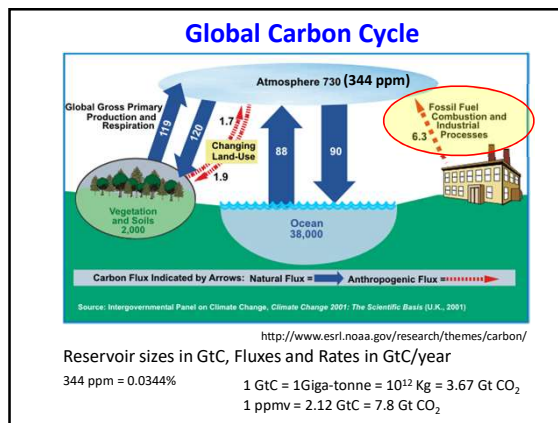
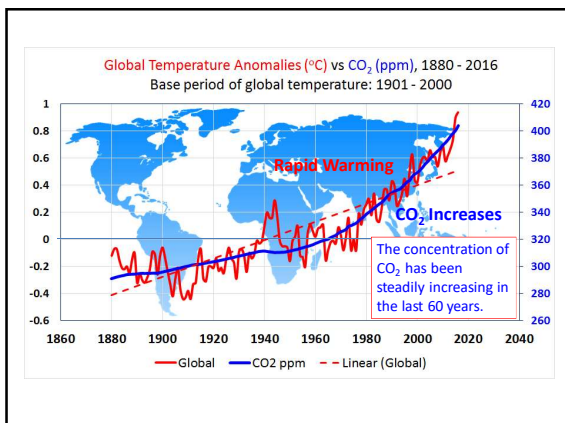


We have **Uncertainties** in observing and understanding the earth's climate!

Such as the observations of **Aerosols, Clouds, Ocean Circulation, Carbon Cycles, and Precipitation.**

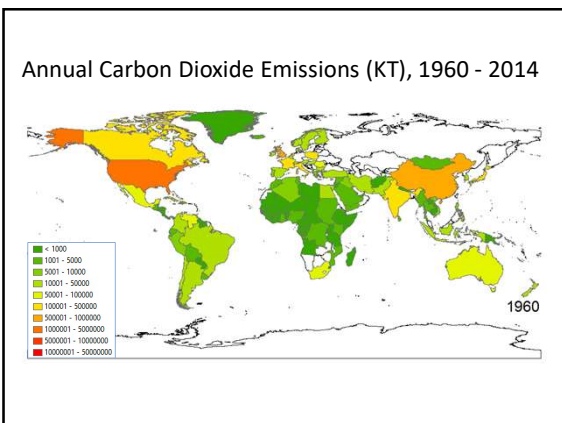
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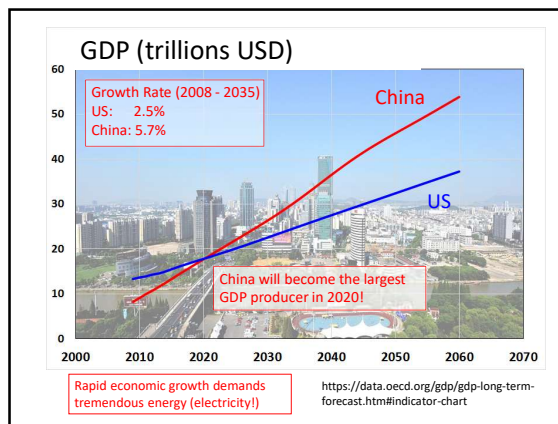
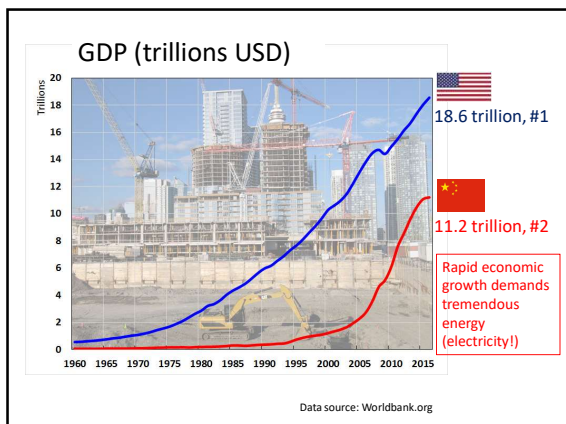
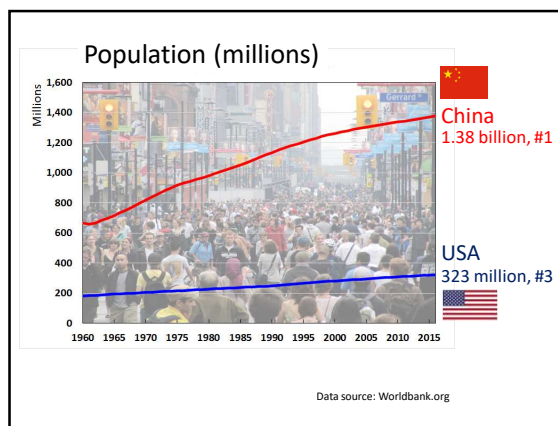


What is China (People's Republic of China, PRC)?

- Located in Asia
- 5,000 years of history and 2,300 years of written language
- PRC was established in 1949 (ROC in 1912)
- Fourth largest country in the world
- Total land area: 3.7 million square miles
- Most populous country with 1.41 billion people (2017)
- 56 ethnic groups, 91% people are Han's
- Beijing is the capital with 21 million people
- Shanghai is the largest city with 23 million people
- Official language is Mandarin
- One party government, Communist Party
- One time zone: China Standard Time zone (UTC +8)

Role of China in Global Climate Change

- China is a global economic powerhouse
- China is the world's smokestack
- China is a political and military superpower



China's rapid economic development in the last 30 years is because:

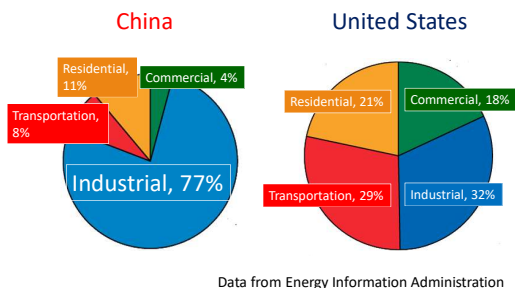
1. After Cultural Revolution (1966-1976), the society is stabilized;
2. Deng Xiaoping's "Four Modernization" in 1978;
3. Deng Xiaoping's "Open-door Policy" for foreign direct investments in 1986;
4. Rural entrepreneurship in 1980s;
5. Establishing "socialist market economy";
6. Manufacturing booming;
7. Massive and cheap labor force;
8. Joining World Trade Organization (WTO) in 2001;
9. Globalization;
10. Rapid expanding domestic infrastructure and market.

China is hunger for energy !

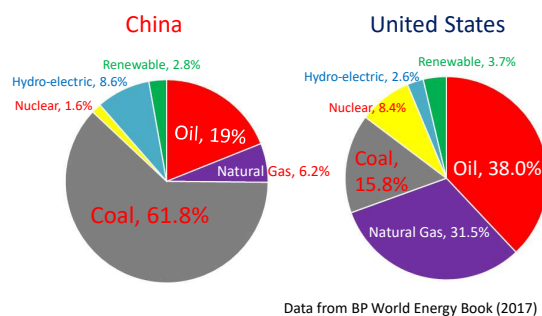
China's Key Energy Statistics	World Rank
Total Primary Energy Production (95.829 Quadrillion BTU, 2014)	1
Total Primary Energy Consumption (123.184 Quadrillion BTU, 2014)	1
Primary Coal Production (4.270 million short tons, 2014)	1
Total Petroleum Consumption (12.020 million per day, 2015)	2
Total Energy Net Generation (5.388 billion kilowatthours, 2014)	1

<http://www.eia.gov/beta/international/country.cfm?iso=CHN>

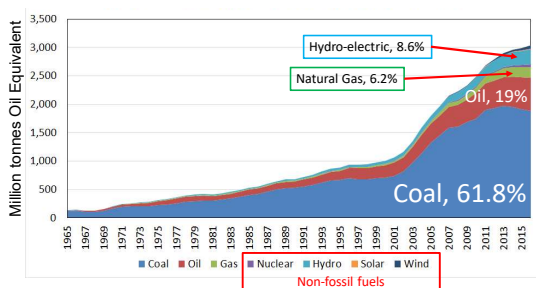
Comparison of Energy Use in China and US



Comparison of 2016 Energy Source in China and US



China's Total Primary Energy Consumption by Source 1965-2016



Why should China be concerned about climate change?

- Climate change hinders economic growth and political stability
- Climate change impacts people's lives and properties
- Climate change interrupts agriculture production
- Climate change affects energy security
- China is under international pressure for actions

What should China do about climate change?

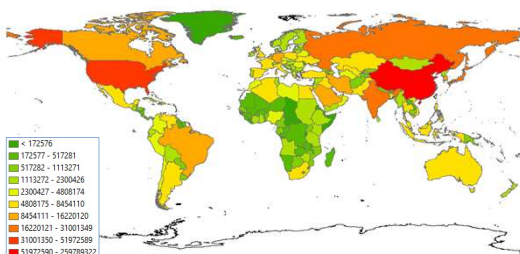
China has to

- continue its **economic development**
- maintain **political stability**
- mitigate the impacts of climate change
- reduce the dependency of coal
- upgrade its **infrastructure** of industry
- defend its **international reputation**

Is China serious about dealing with the issues of climate change?

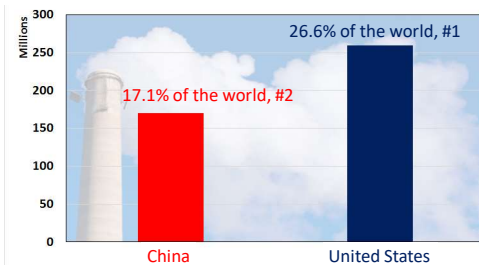
They do have strong arguments while negotiating the deals of climate change on the international stage.

1960 – 2014 Total Carbon Dioxide Emissions (KT)

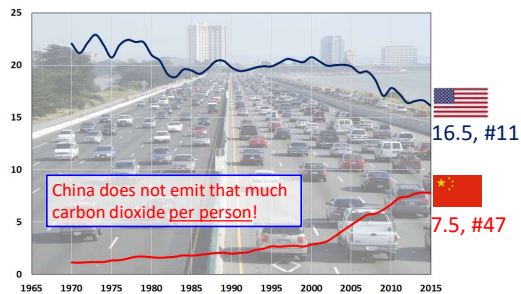


US, China, Russia, India emit most

Total Carbon Dioxide Emissions in Millions of Tonnes from 1960 to 2014

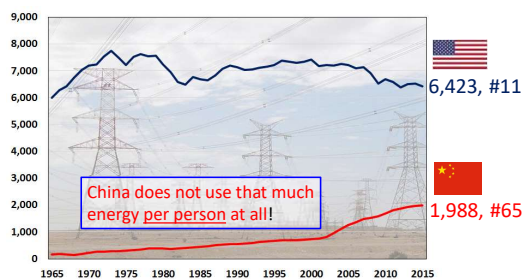


CO₂ per capita (tons per person), China vs US

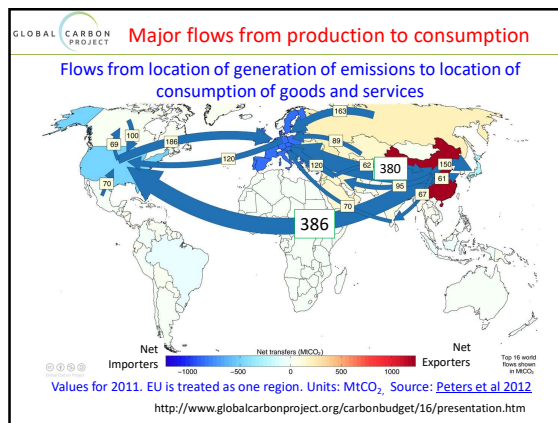
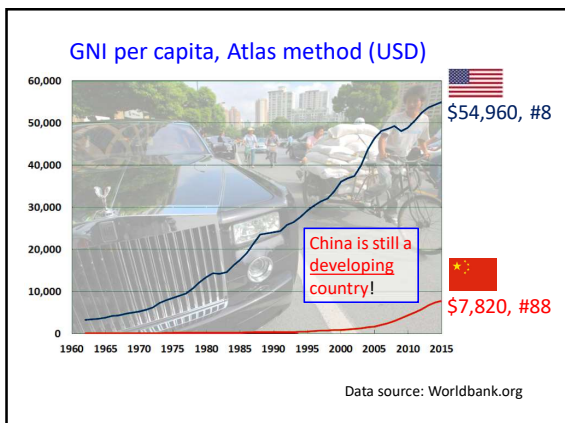


Data source: Worldbank.org

Energy Use (kg of oil equivalent per capita)



Data source: Worldbank.org



Is China serious about dealing with the issues of climate change?

What do you think?

- China's Challenges in the 21st century**
- Air and Water pollutions
 - Water scarcity
 - Economic disparity
 - Imbalanced developments between east and west
 - Social unrest
 - Governmental accountability and anti-corruption
 - Population growth and aging population
 - Quality of citizenry
 - Education inequality
 - Rebalancing economy
 - **Climate change**

- In short**
- Climate change is happening in China;
 - China plays a significant role in dealing with issues of global climate change;
 - China faces environmental crises generated by rapid economic growth and high energy demand;
 - China recognizes and acts upon issues of climate change;
 - Actions demand dramatic transformation in infrastructure in China;
 - China steps up to deal with climate change as the leader of the world;
 - **Continued economic growth and secured political status are the priorities of the Chinese government.**

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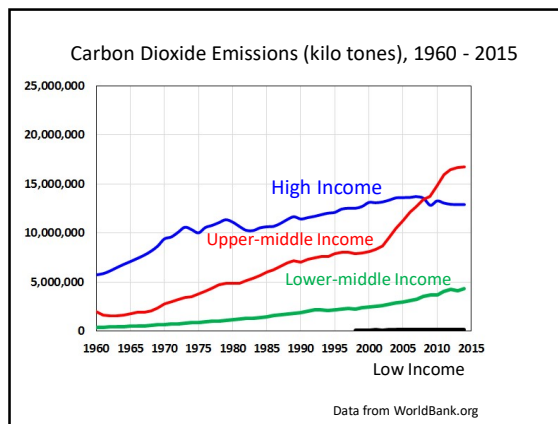
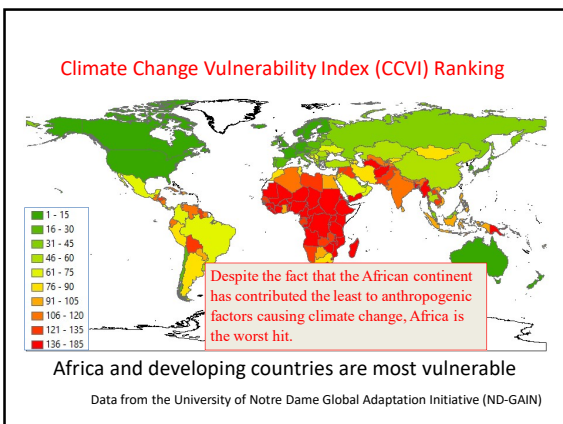
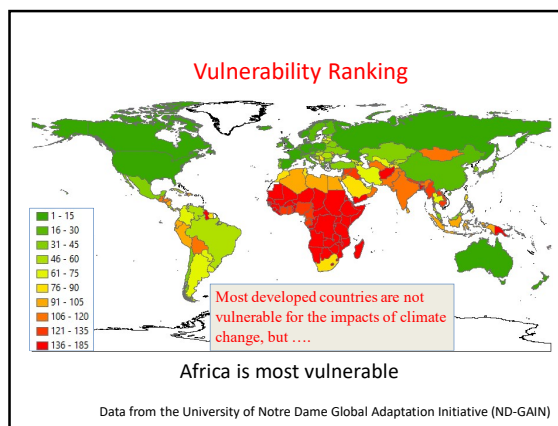
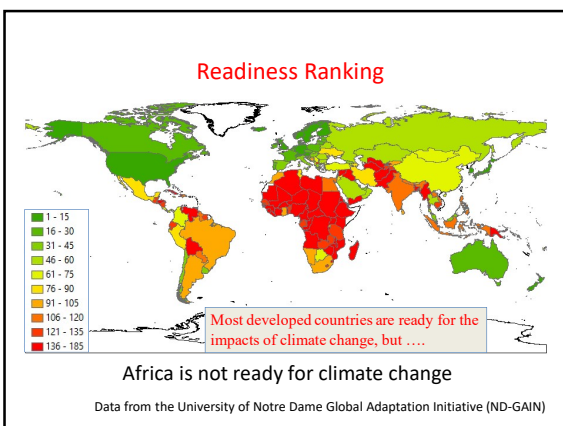
Climate Change Affects Everything that Everyone Does Everywhere !

<http://epa.gov/climatestudents/impacts/effects/index.html>

What to Expect in Climate Change?

- Accelerating **sea level rise** and increased coastal flooding
- Increased **oceanic acidity**
- More frequent and intense **heat waves**
- Increased **extreme weather** events (drought and flooding)
- Widespread **forest fires**
- Shortage of fresh water
- Changing seasons
- Migration of animals and plants
- Destruction of coral reefs
- Growing health impacts

<http://epa.gov/climatestudents/impacts/signs/index.html>



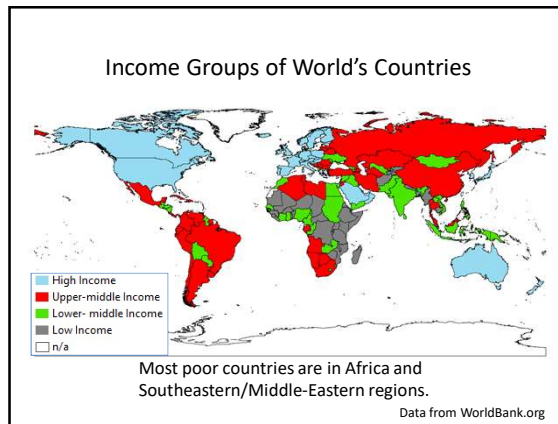
According to World Bank Country and Lending Groups

Income Group	GNI per capita
High Income	> \$12,236
Upper-Middle Income	\$3,956 - \$12,236
Lower-Middle Income	\$1,006 - \$3,955
Low Income	< \$1,005

■ High Income
■ Upper-middle Income
■ Lower- middle Income
■ Low Income
 n/a

GNI: Gross National Income

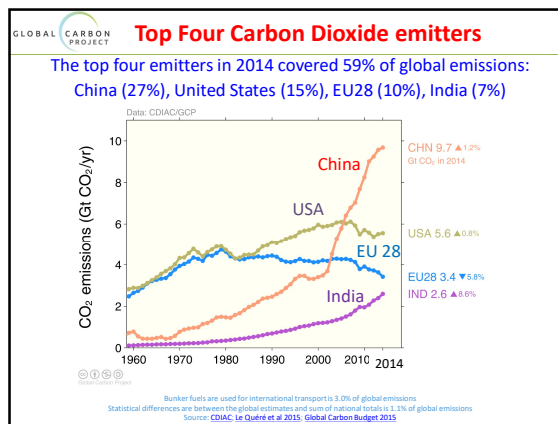
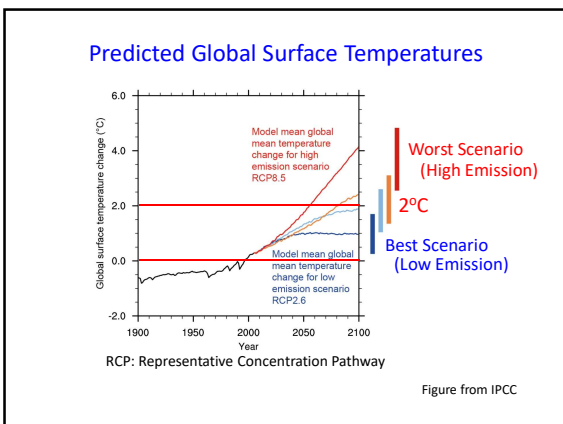
Data from WorldBank.org

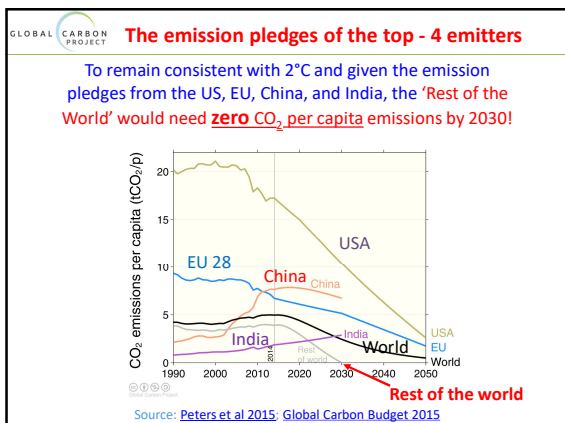


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Will the **2015 Paris Agreement** Succeed in Reducing Global Carbon Dioxide Emissions?





What is the United States doing to cut down Carbon Dioxide Emissions?

U.S., China Reach 'Historic' Deal to Cut Emissions at APEC (Asia-Pacific Economic Cooperation), November 10-12, 2014
 Calum MacLeod and Melanie Eversley, USA TODAY 8:54 a.m. EST November 12, 2014

U.S. President Obama smiles as he walks with Chinese President Xi Jinping during a welcome ceremony at the Great Hall of the People in Beijing on Nov. 12, 2014. (Photo: Andy Wong, AP)

- **China** intends to **peak carbon dioxide emissions around 2030**, and increase the **non-fossil fuel** share of all energy to around **20%** by 2030.
- The **United States** will double the pace of carbon emission reduction to **26% to 28% of its 2005 level**.

<http://www.usatoday.com/story/news/world/2014/11/11/china-climate-change-deal/18895661/>

Photo: Matthew Brown, AP

Clean Power Plan proposed by President Obama in August 2015 aims to reduce **carbon dioxide** emissions from power plants by nearly **32% from 2005 levels over the next 15 years**.

2/9/2016: Supreme Court blocks Obama's Clean Power Plan

The Clean Power Plan is the Obama administration's initial contribution to a **historic climate change agreement** reached in **Paris** in December 2015 by 195 nations.

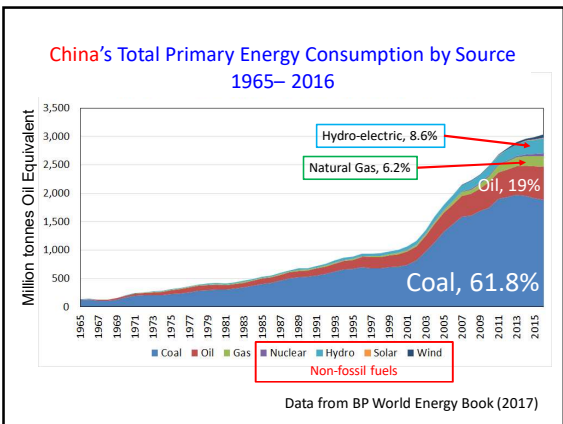
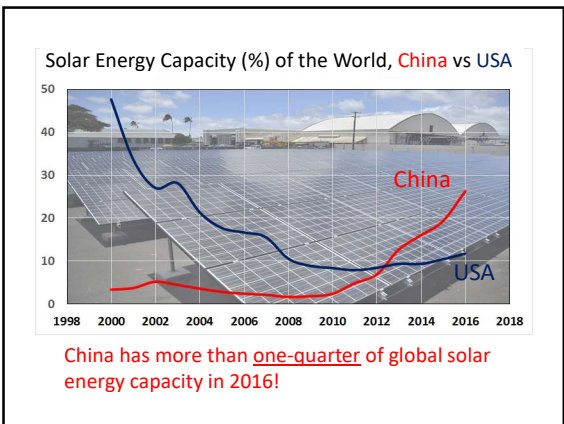
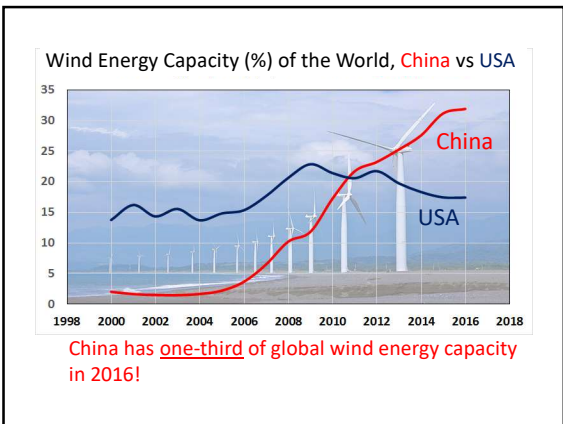
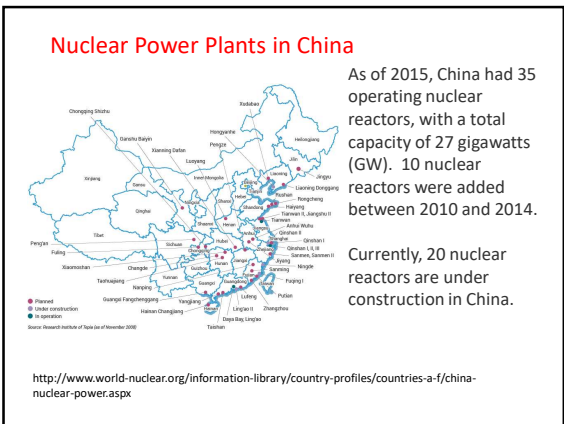
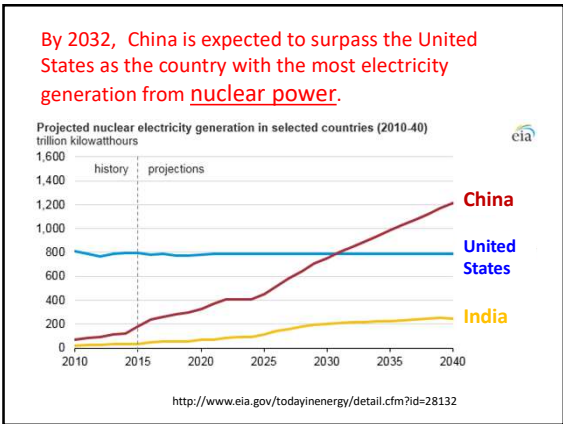
With the Supreme Court's hold in place, the United States may not be holding up its part of the deal.

June 1, 2017 **theguardian**
 Donald Trump confirms US will **quit** Paris climate agreement.

June 7, 2017 **The New York Times**
 The earliest date for the United States to **completely withdraw** from the agreement is **November 4, 2020**, around the time of the next U.S. presidential election.

August 5, 2017 **REUTERS**
 The U.S. State Department has **officially informed** the United Nations it will withdraw from the Paris Climate Agreement in a document issued on **August 4, 2017**, but left the door open to re-engaging if the terms improved for the United States.

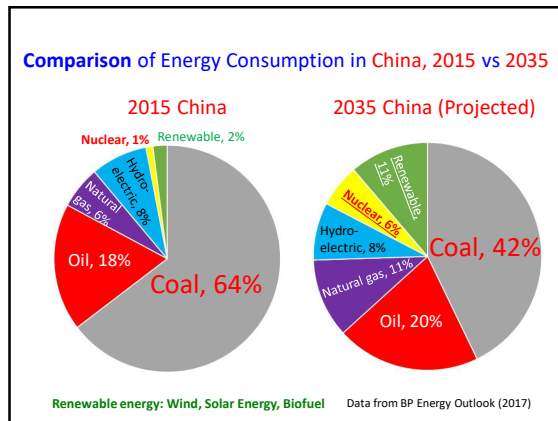
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Wind and Solar Energy in China



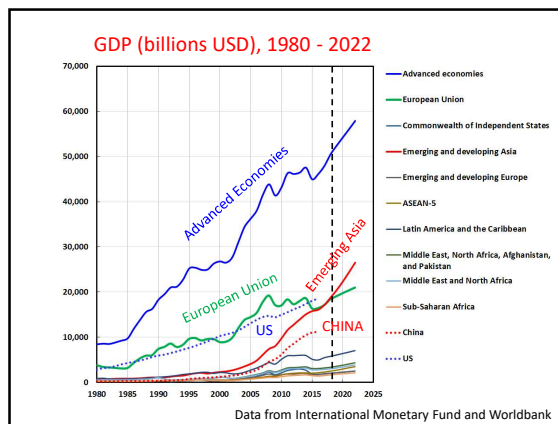
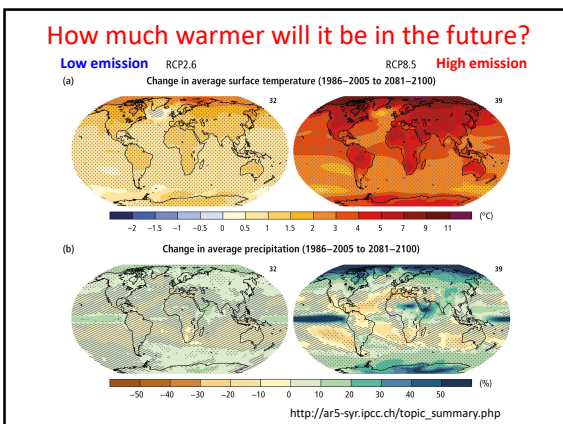
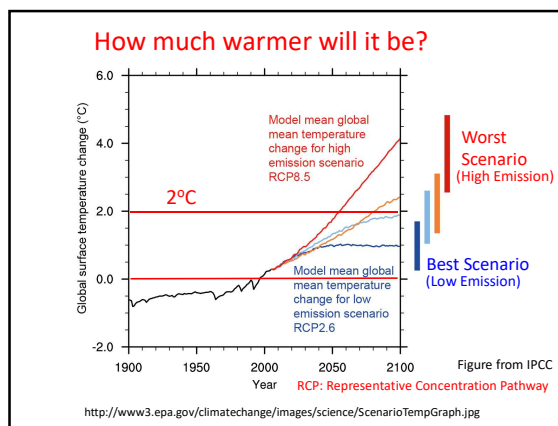
Wind and solar energy only accounts for less than 8% of total electricity generation in 2015, but it is targeted to become 14% in 2040!

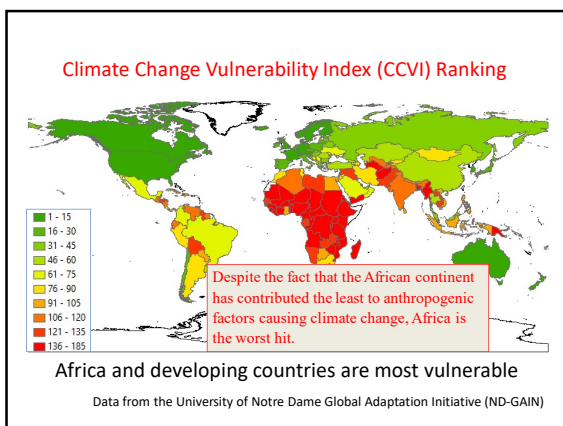
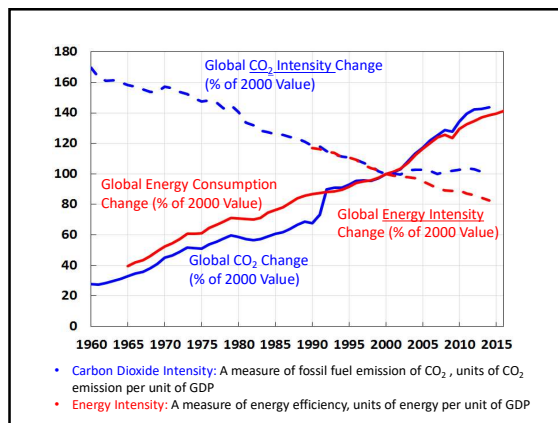
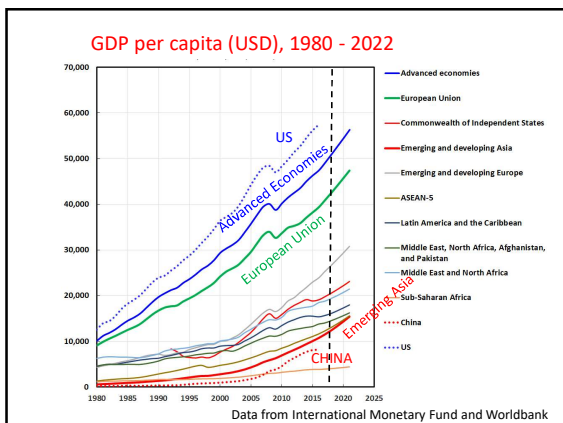


Outline



- Evidences of Climate Change
- Causes for Climate Change
- Carbon Dioxide and Climate Change
- China's Role in Climate Change
- Impacts of Climate Change
- Actions on Climate Change
- **Future Climate and Global Economy**





What can we DO about climate change?

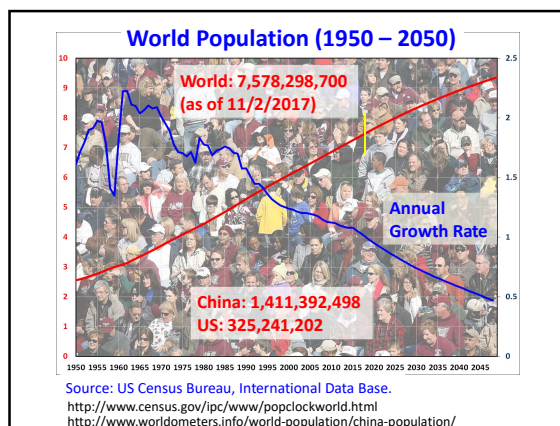
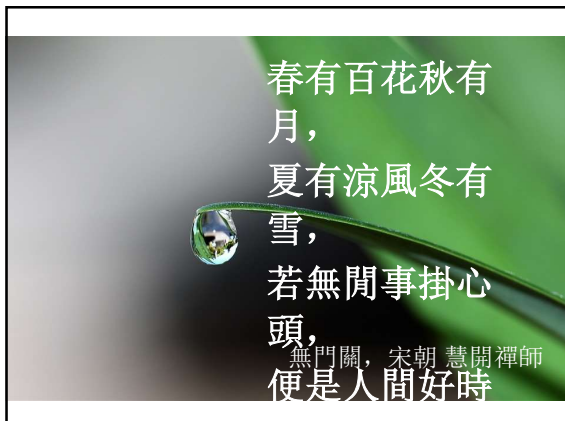
- Develop **renewable** energy
- Advance **green** technology
- Strengthen international **cooperation**
- Accelerate **balanced** economic progress
- Do **your share** of protecting the environment

<http://epa.gov/climatestudents/impacts/effects/index.html>

Summary

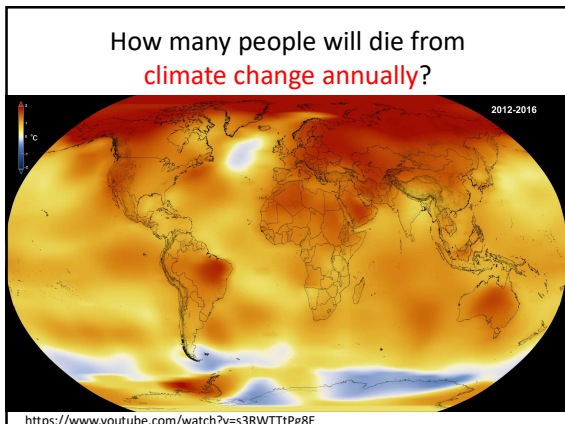
- Climate change is happening as it should be
- Climate change is natural and human-made
- Advancing technology helps
- Green energy is expanded but inadequate
- Personal responsibilities are good but limited
- International cooperation is critical
- Impacts of climate change vary between nations
- Global economy continues to grow
- Inequality of global economy is paramount
- China plays a significant role in climate change





How do we Survive with 8.3 billion people on earth in 2030 ?





For Comparison:

How many people died in Tangshan earthquake in China on July 28, 1976?	400,000
How many people died in Indian Ocean Tsunami on December 26, 2004?	280,000
How many people died in Cyclone Nargis in Myanmar on May 2, 2008?	138,000
How many people died in Haiti Earthquake on January 12, 2010?	160,000
How many people have died in Syria civil war conflict since 2011?	400,000

How many people died due to suicide worldwide in 2016?	800,000
How many people died in traffic accidents worldwide in 2013?	1.25 million
How many children under 5 years old died worldwide in 2015?	5.9 million
How many people died because of Tobacco use worldwide in 2016?	6 million
How many people died from heart attack worldwide in 2012?	17.5 million
How many people died in Taiwan in 2015?	163,858

<http://www.who.int/mediacentre/news/releases/2015/child-mortality-report/en/>
http://www.who.int/gho/road_safety/en/
<https://eng.stat.gov.tw/lp.asp?CtNode=2265&CtUnit=1072&BaseOSD=36&mp=5>

Don't we Have Enough Crises to deal with currently?

What do you think?