



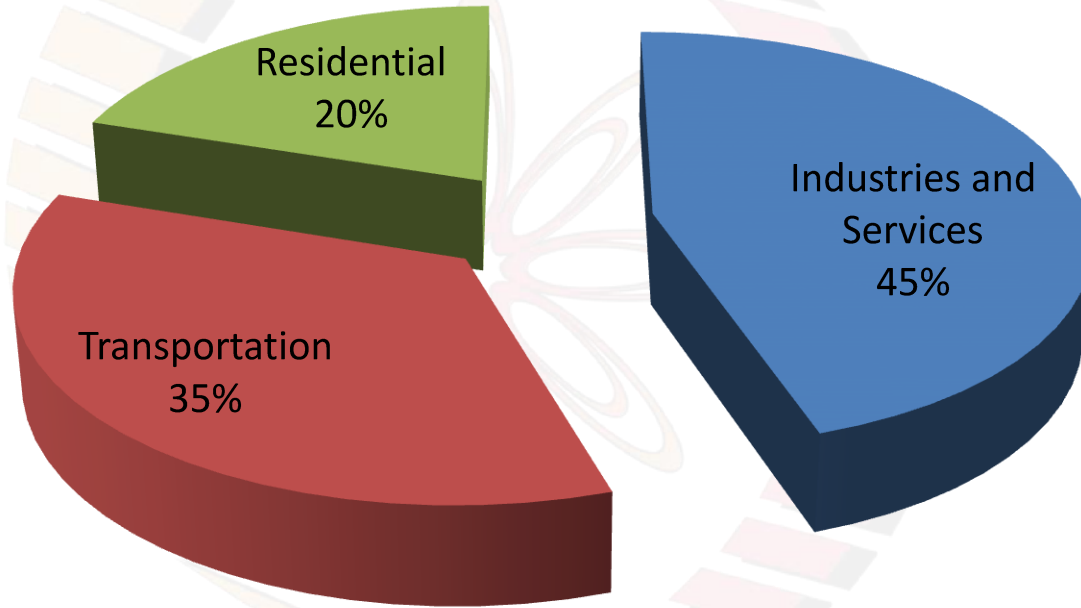
Energy Consumption



Learning objectives:

- 1) To become aware of the consumption pattern of energy across sectors
- 2) To become aware of energy usage across nations and their populations

Energy consumption by sector



Data Source: Key World Energy Statistics 2017; International Energy Agency (IEA)

Energy Poverty

17% Lack access to electricity

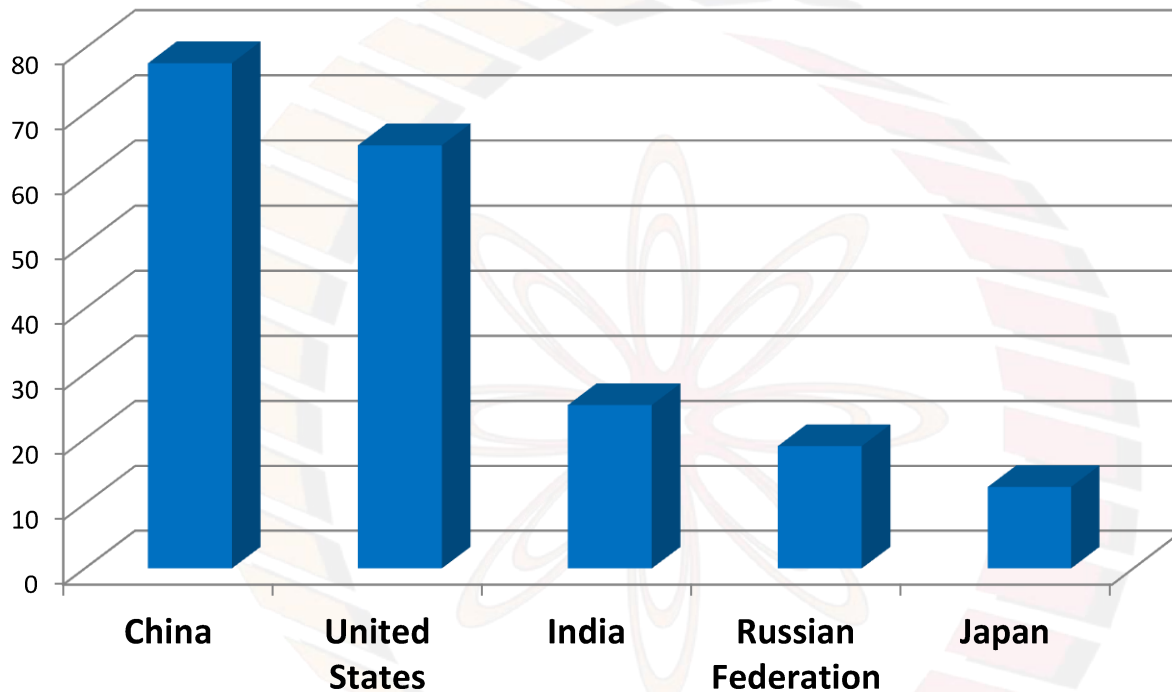
38% lack access to clean cooking facilities

95% of these people live in Sub Saharan Africa, or Asia

80% of these are in Rural Areas

<http://www.iea.org/topics/energypoverty/>

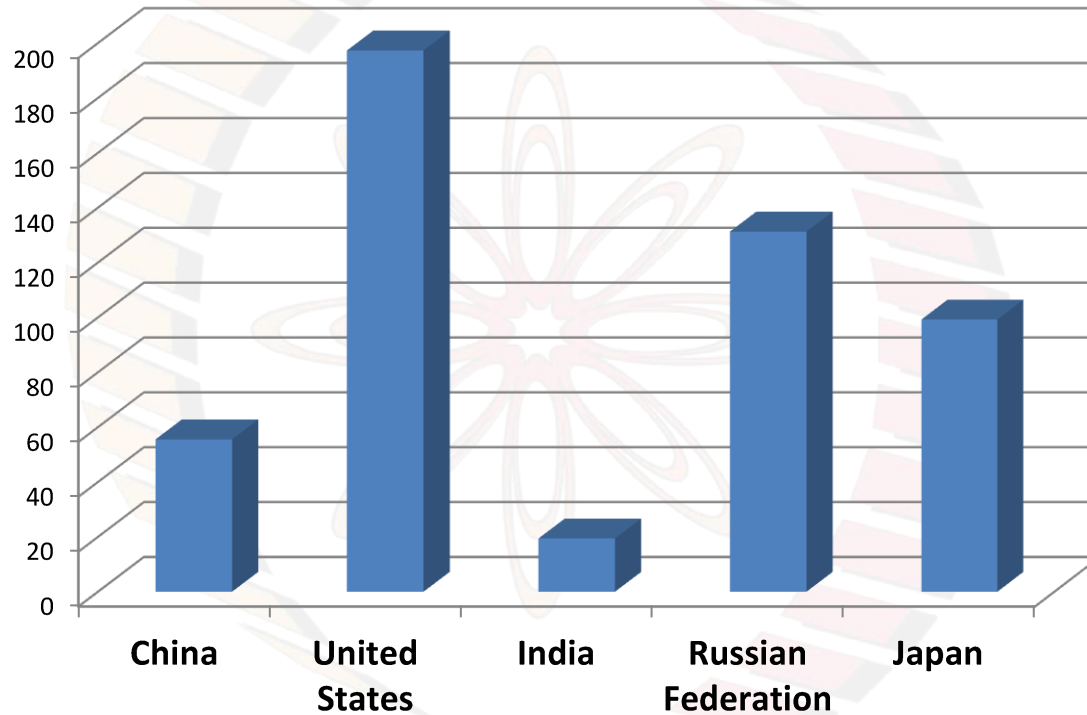
Top 5 Nations based on Total Energy Consumption (Annual)



Humans use 500 Exa Joules of energy annually
1 Exa Joule = 10^{18} Joules

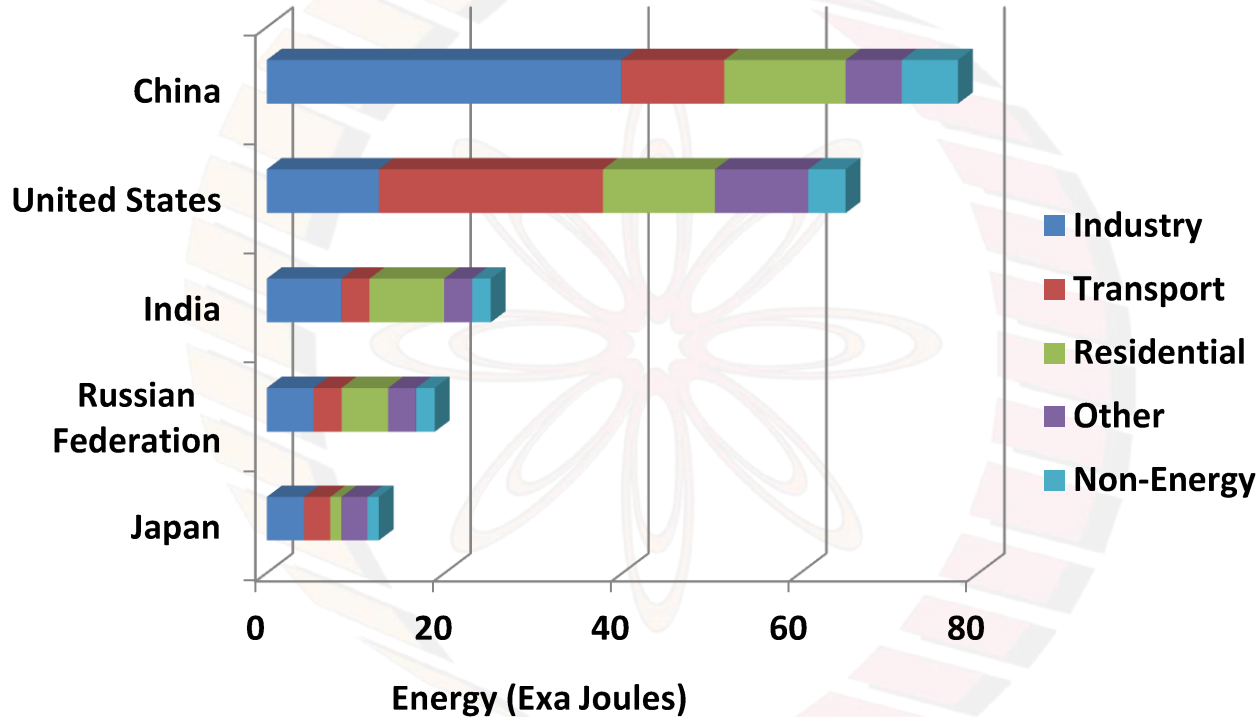
Data Source: Key World Energy Statistics 2017; International Energy Agency (IEA)

Per Capita Energy Consumption (Annual)



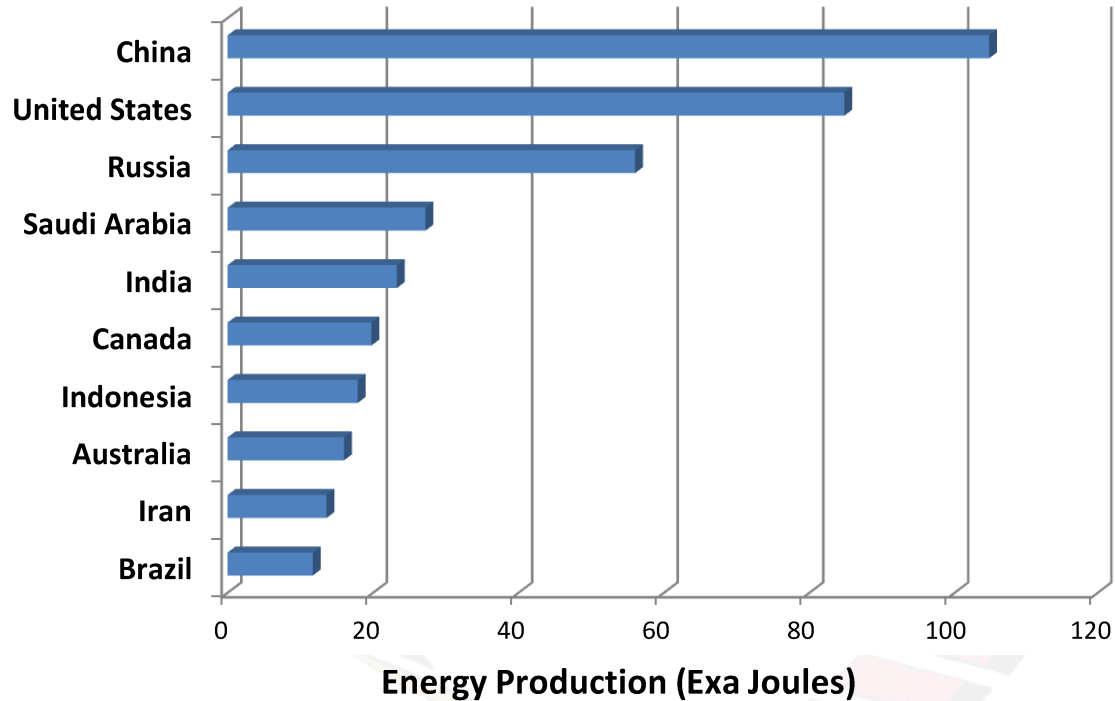
Data Source: Key World Energy Statistics 2017; International Energy Agency (IEA)

Top 5 Nations based on Total Energy Consumption (Annual) Sector wise distribution



Data Source: Key World Energy Statistics 2017; International Energy Agency (IEA)

Top 10 Nations based on Total Energy Production (Annual)



<https://www.iea.org/statistics/statisticssearch/>
2015 data

10^{18}



World energy usage per year : 500 exa joules

Image Credit NASA

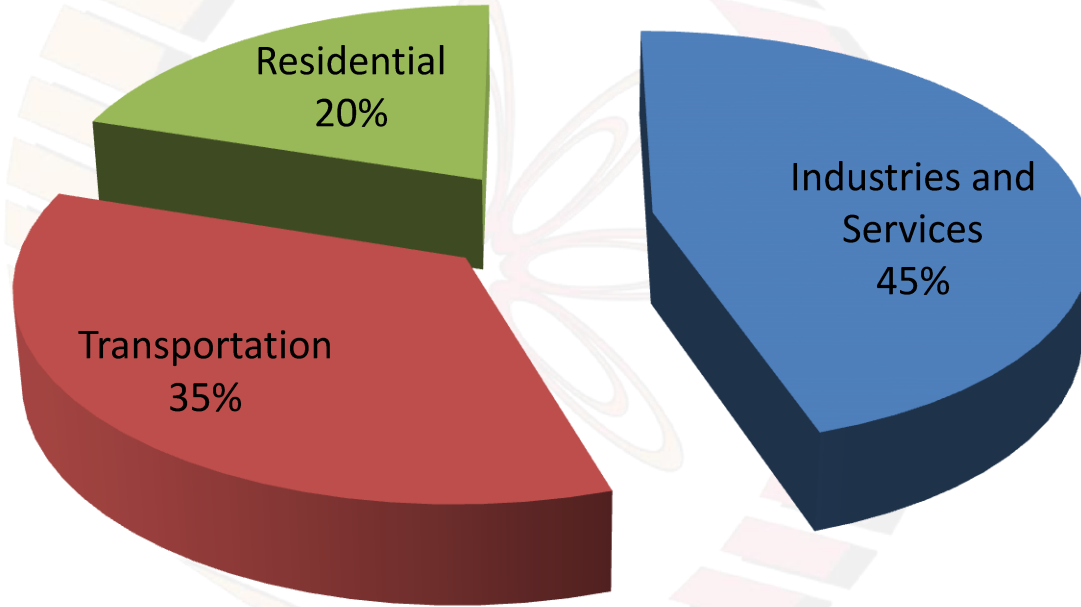


Split up of Energy usage

Learning objectives:

- 1) To become aware of the details of consumption within each sector
- 2) To become aware of sector wise scope for improved energy efficiency

Energy consumption by sector



Data Source: Key World Energy Statistics 2017; International Energy Agency (IEA)

Industrial sector:

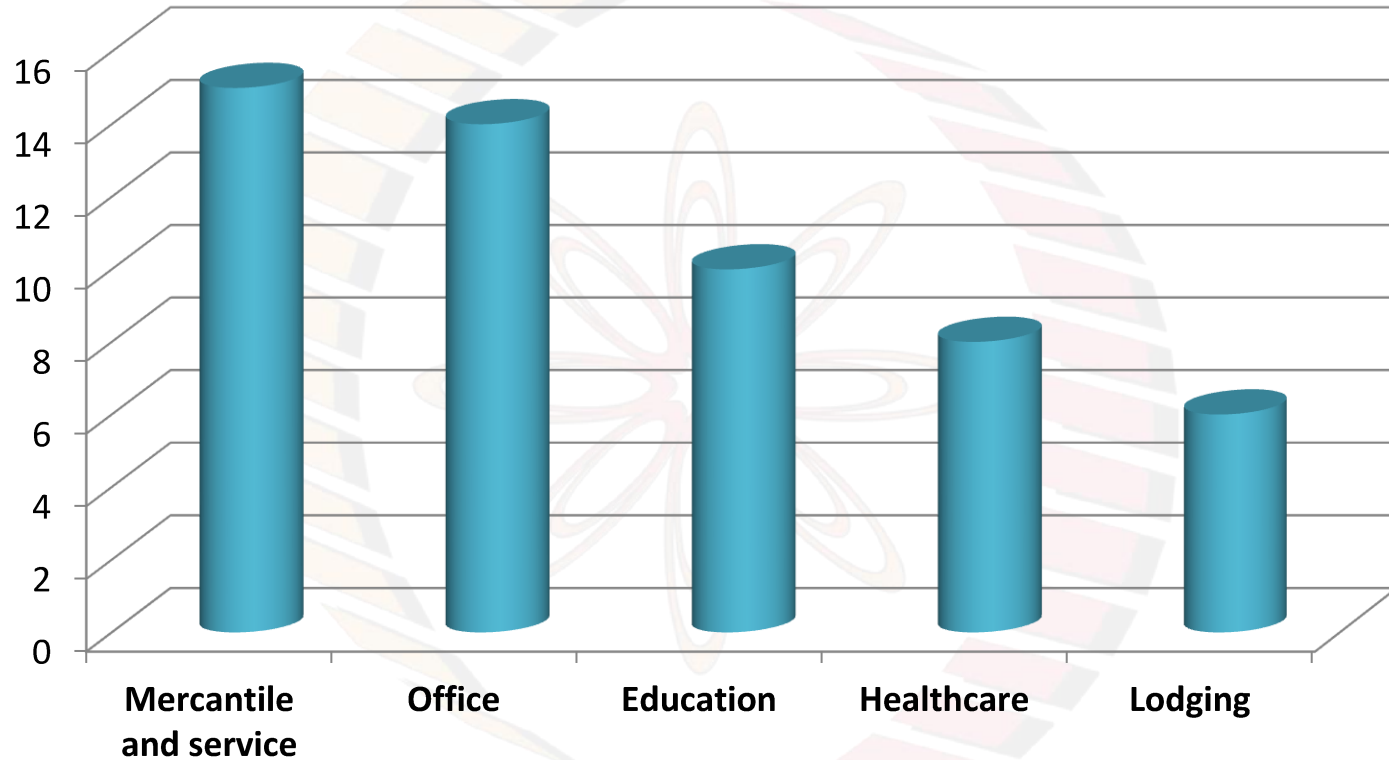
(Oil refining, Metallurgical processes, Glass manufacture)

- 1) **Process heating:** Raising temperature of components during manufacturing
- 2) **Refining Crude oil:** Separation of products
- 3) **Boiler heating:** To generate steam

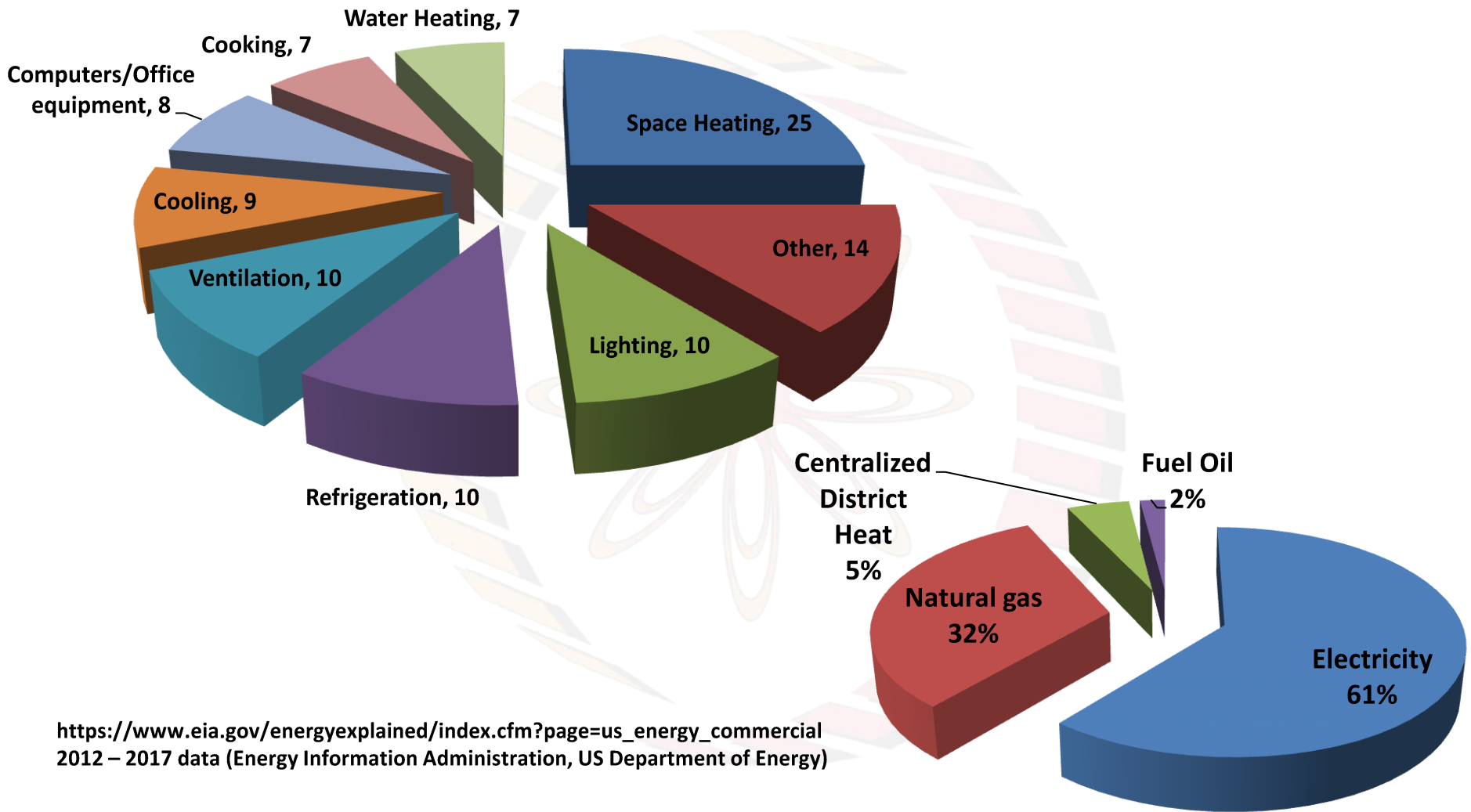
Primary: Natural gas and oil

Secondary: Electricity

Top 5 Energy Consuming Buildings

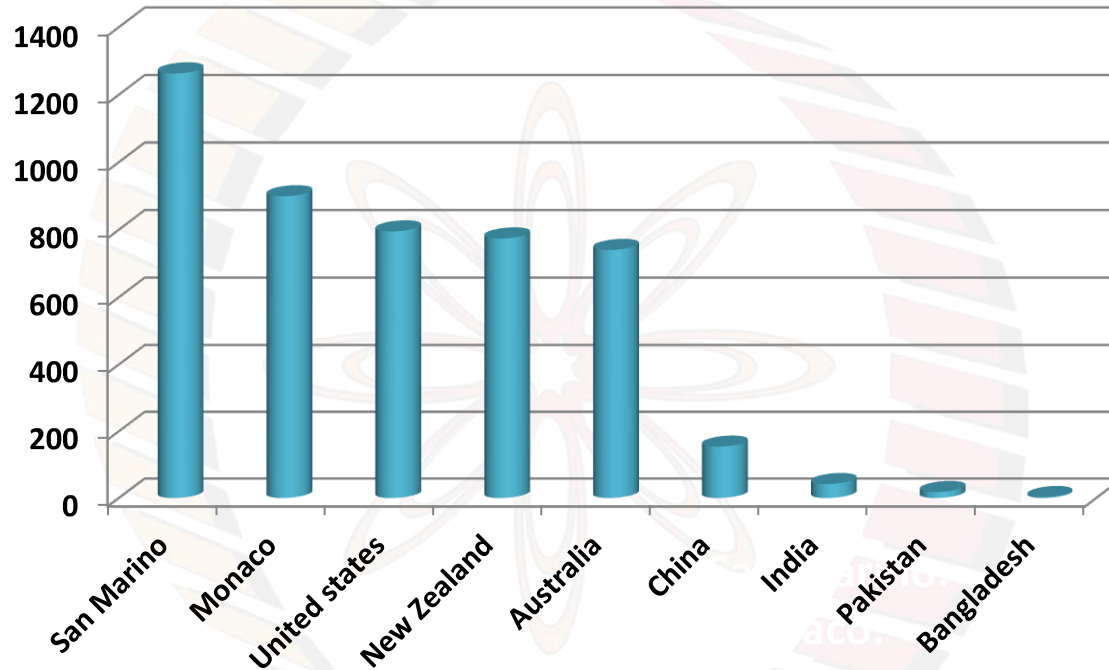


https://www.eia.gov/energyexplained/index.cfm?page=us_energy_commercial
2012 – 2017 data (Energy Information Administration, US Department of Energy)



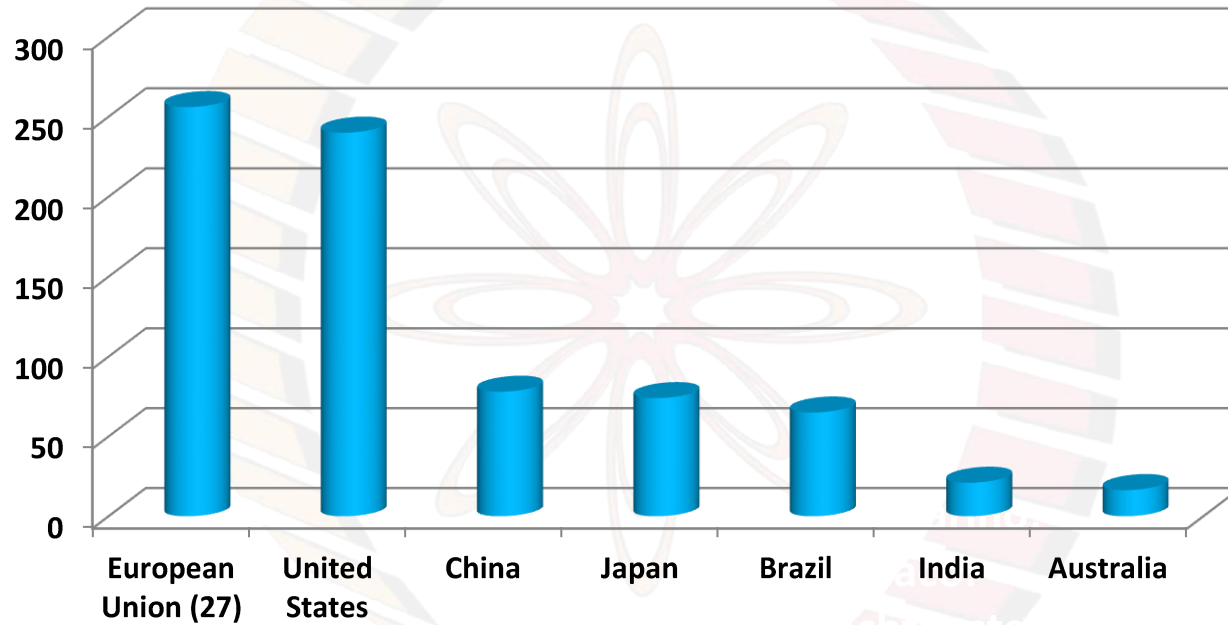
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2012 – 2017 data (Energy Information Administration, US Department of Energy)

Vehicles per 1000 people



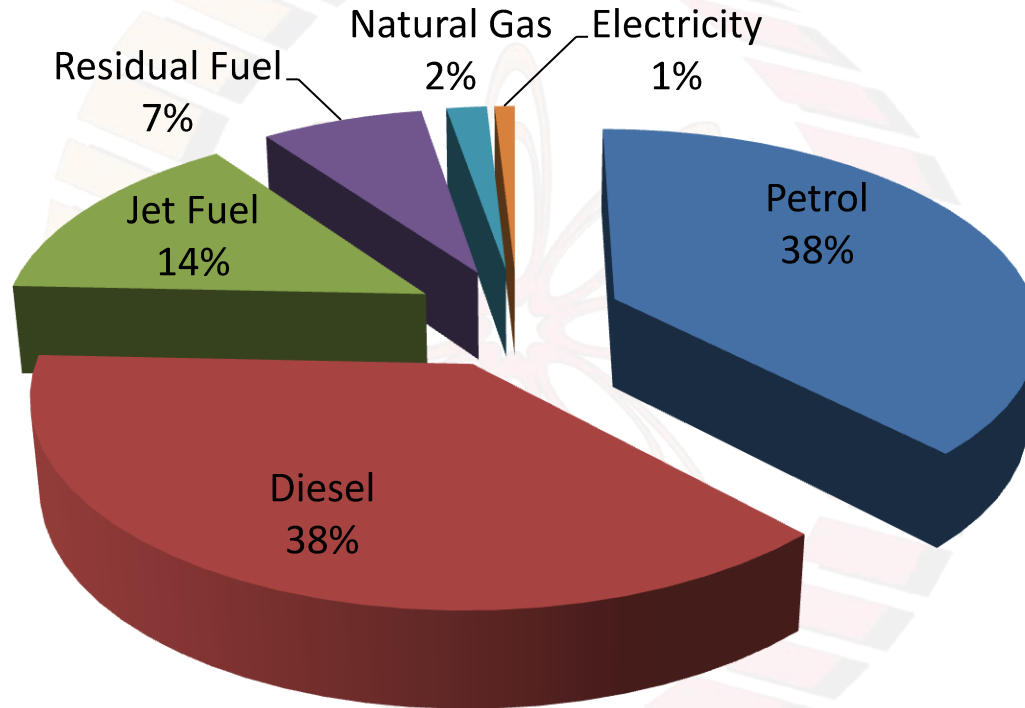
https://en.wikipedia.org/wiki/List_of_countries_by_vehicles_per_capita
2014 - 2016 data

Total Vehicle Population



https://en.wikipedia.org/wiki/Motor_vehicle
2010 - 2011 data

Sources of Fuel for Transportation Sector



Source: <https://www.eia.gov/analysis/studies/transportation/scenarios/pdf/globaltransportation.pdf>
2015 Data

The background features a large, faint circular arrow pointing clockwise, composed of many small, overlapping rectangular segments in shades of yellow and orange. In the center of this circle is a stylized, multi-lobed star or flower-like shape with a pinkish-red center and yellowish-orange outlines.

Traffic jam – wasted energy!
Wasted time



Carbon dioxide emissions (grams) per passenger mile

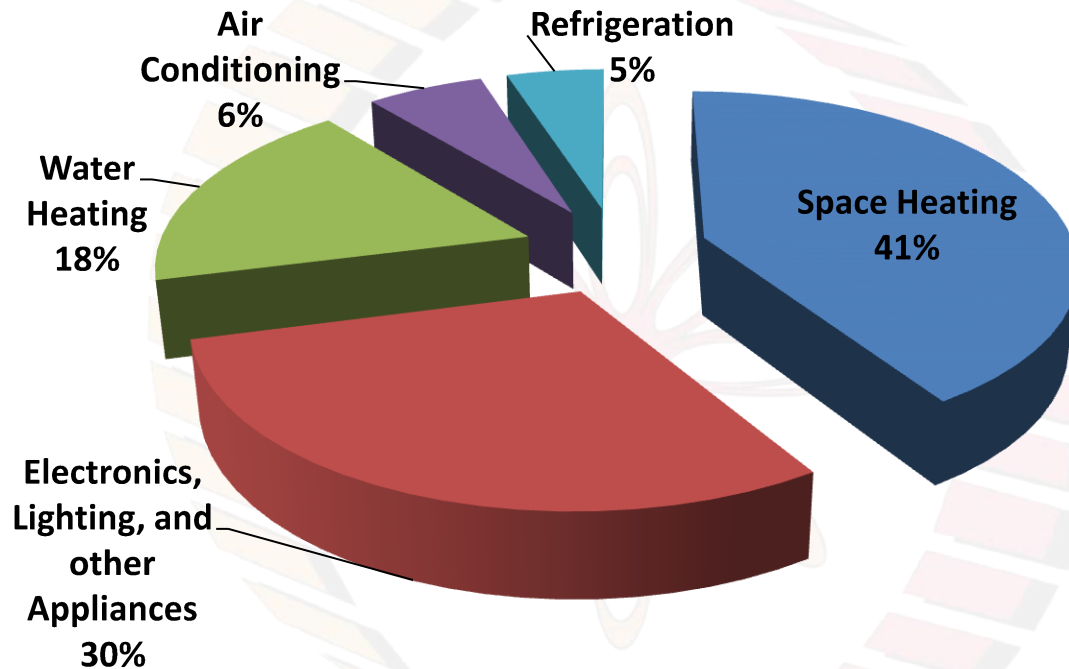
Old car Vs New car

1 person in a car Vs a carpool

Train/Bus Vs Carpool

Train/Bus Vs Flight

Use of Energy in a Home



https://www.eia.gov/energyexplained/index.cfm?page=us_energy_homes
2009 Data

Conclusions:

- 1) Considerable nuances in the energy supply and use scenario
- 2) Non conventional energy sources making only a limited intervention across sectors at this time

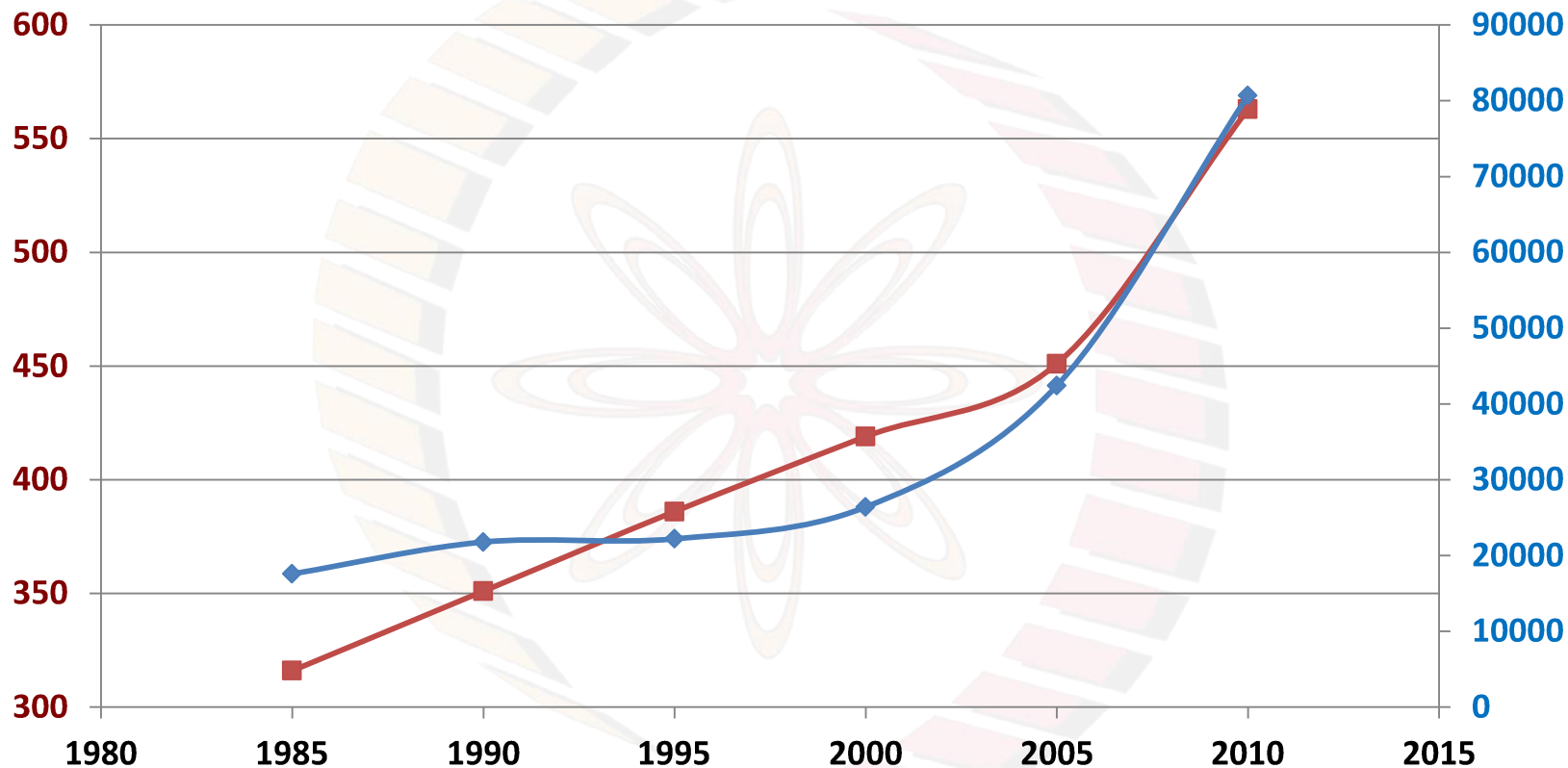


Consequences of Energy Consumption

Learning objectives:

- 1) To become aware of the link between energy usage and 'development'
- 2) To become aware of the impact of energy usage on the environment

India: GDP and Energy Usage



Data from: World Bank

Five highest GSDPs in India

Maharashtra
Uttar Pradesh
Tamil Nadu
Karnataka
Gujarat

Power Installed/allocated

First in Western Region
Second in Northern Region
First in Southern Region
Second in Southern Region
Second in Western Region

Some States with lower power installed/allocated

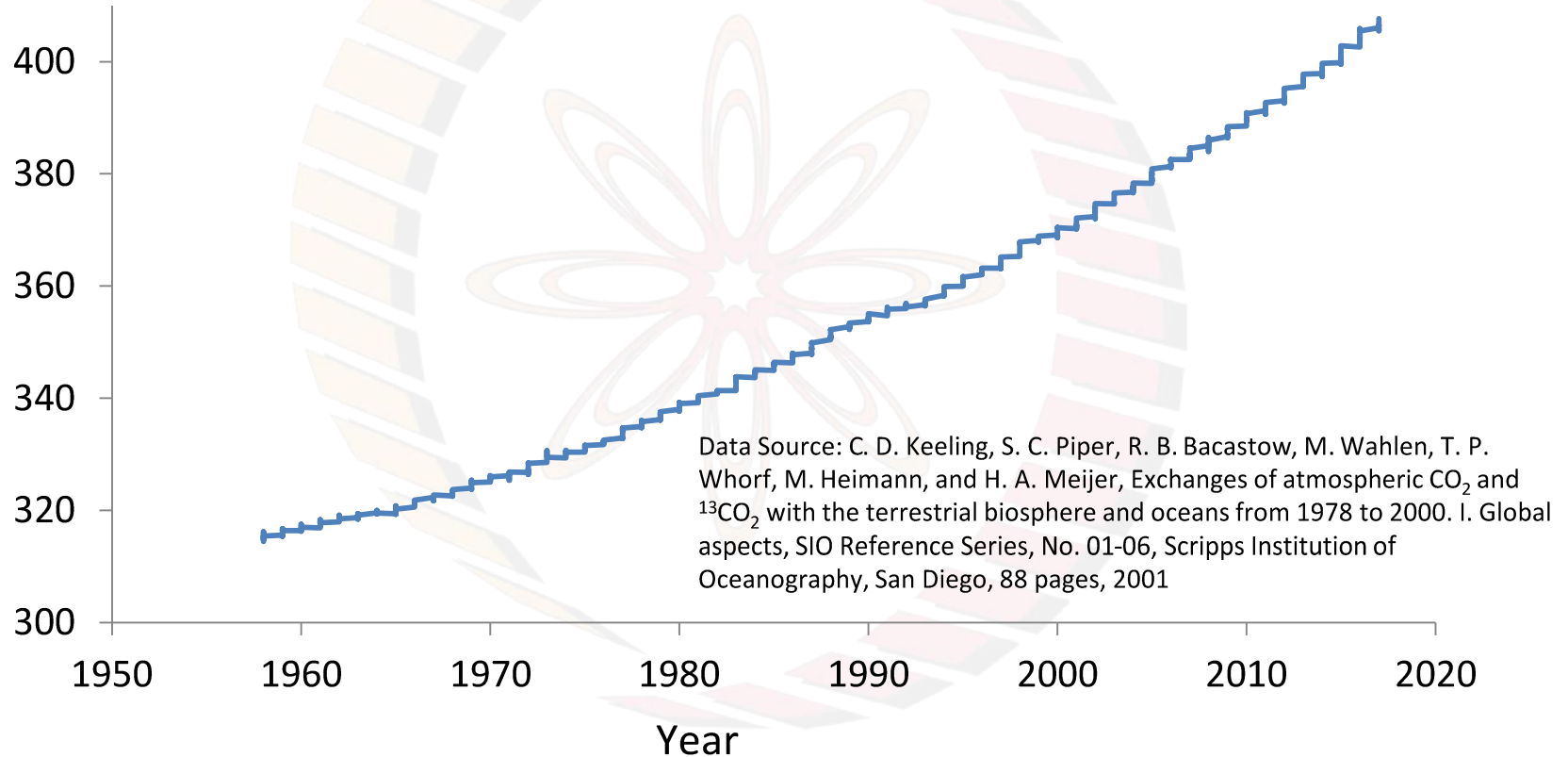
Arunachal Pradesh
Manipur
Nagaland
Mizoram

Source:

https://en.wikipedia.org/wiki/List_of_Indian_states_and_union_territories_by_GDP

https://en.wikipedia.org/wiki/States_of_India_by_installed_power_capacity

Atmospheric CO₂ concentrations (ppm) derived from in situ air measurements at Mauna Loa, Observatory, Hawaii

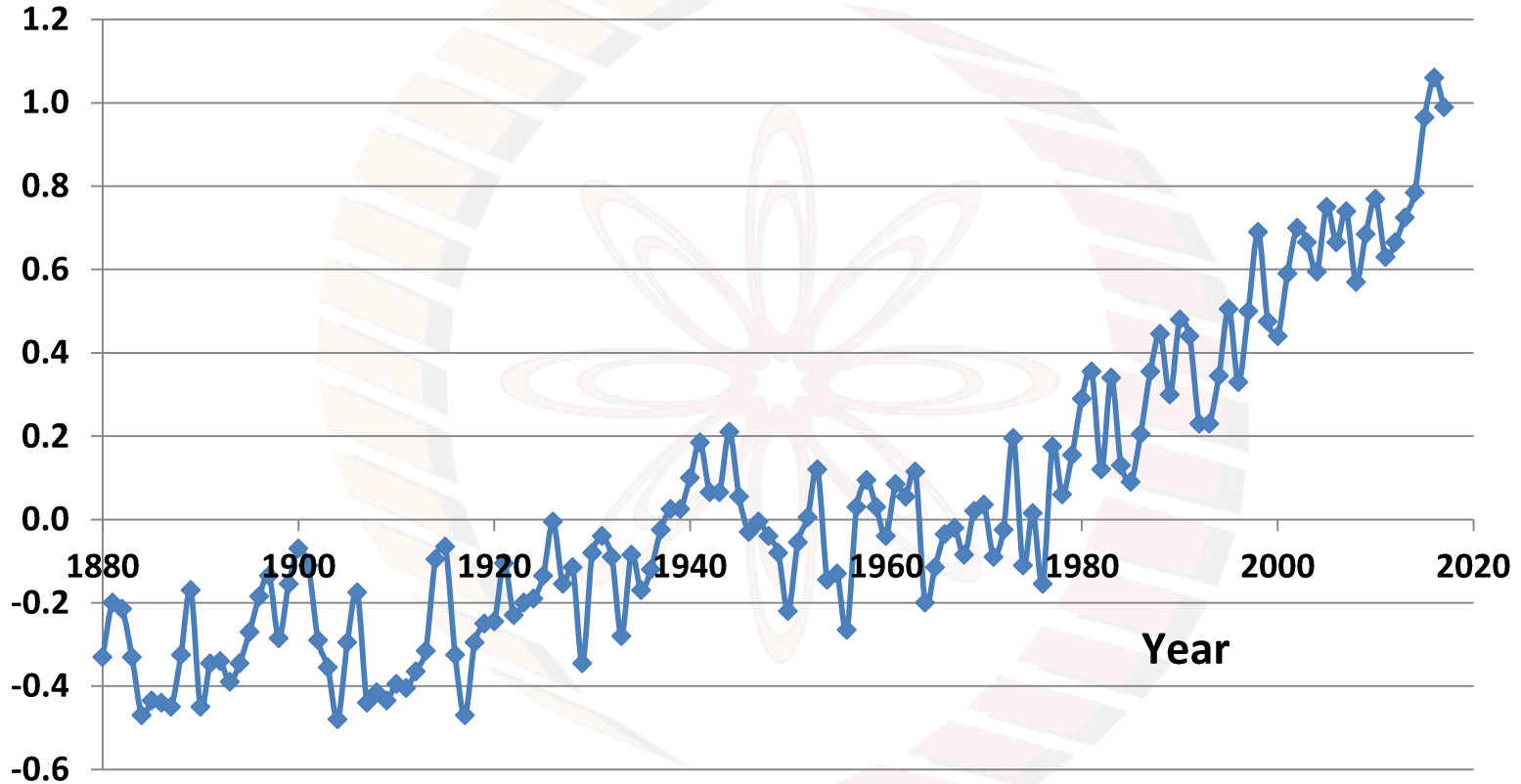




Using bubbles of air trapped in ice it has been determined that CO₂ in air has never been above 300 ppm in 400,000 years

Energy usage in present form is changing environment in a never seen before manner

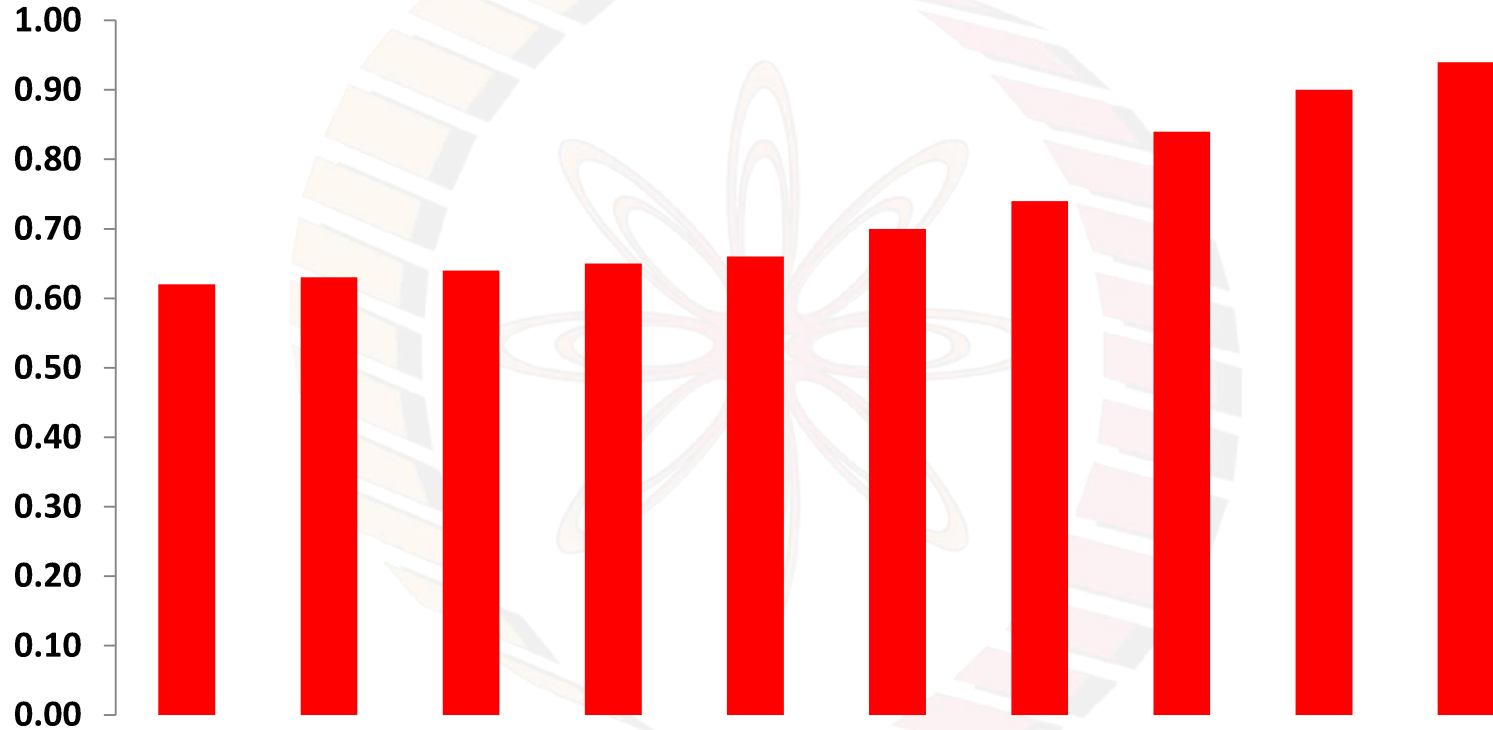
Global Land Ocean Temperature Anomalies



Data Source:

https://data.giss.nasa.gov/gistemp/graphs/graph_data/Temperature_Anomalies_over_Land_and_over_Ocean/graph.txt

Ten Warmest Years Globally, based on Temperature Anomalies



Data Source: National Oceanic and Atmospheric Administration (NOAA), US Department of Commerce

Conclusions:

- 1) Significant link between 'development' and energy usage
- 2) Significant impact of present form of energy usage on environment