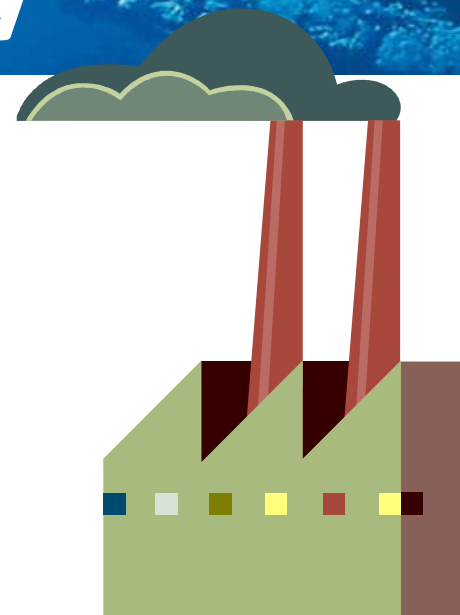


# Energy Basics



International  
Energy Agency

## What is Energy?

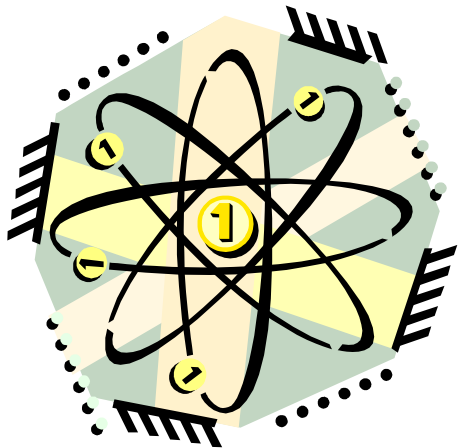


**Energy = Ability to do useful  
work**



The total amount of energy  
in a system remains  
constant over time

Energy can neither be created  
nor destroyed



$$E=mc^2$$



**Chemical Energy**



**Electro-static Energy**



**Nuclear Energy**



**Magnetic Energy**



**Gravitational Energy**



**Food energy**



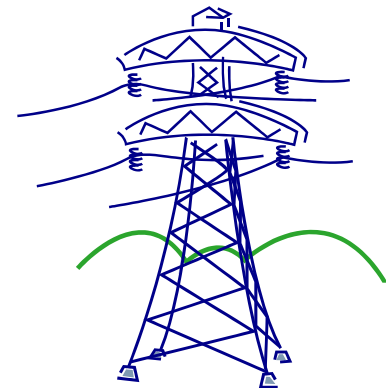
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**Combustion**



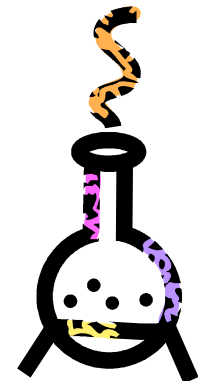
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**Chemistry**



=



## Harnessing Electro-static Energy

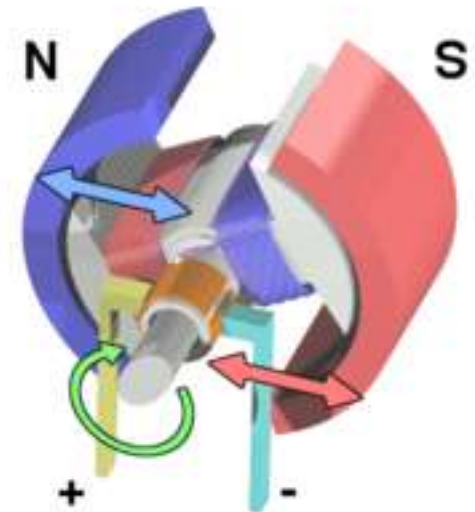
**From**



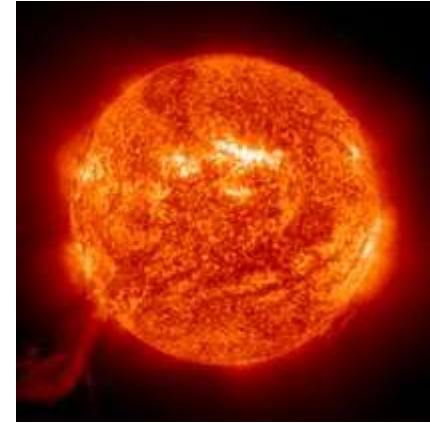
**to**



**Electro-static potential + magnetic energy**



## Fusion



## Fission



**Kinetic energy**



=



**Potential energy**





**James Watt**



=



**First practical version of  
steam engine**

**Watt = 1 Joule per second**

**Watt-hour = 3600 Joules**

**James Prescott  
Joule**



$$Q = I^2 \times R \times t$$

$$\delta U = \delta Q - \delta W$$

**Total Energy Applied = Heat  
Generated - Work Produced**

**Law of Conservation of Energy**

**Joule = 0.2388 calories**

**Alessandro  
Volta**



=



**First practical battery = Volta pile**

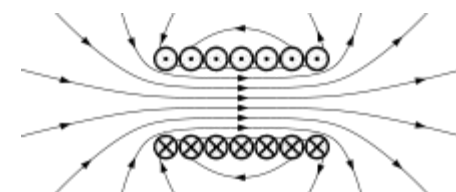
**Power (Watts) = Voltage x  
Current (Amperes)**

## André-Marie Ampère



=

### Electromagnetism



1. Electric charges attract or repel one another with a force inversely proportional to the square of the distance between them: unlike charges attract, like ones repel.
2. Magnetic poles (or states of polarization at individual points) attract or repel one another in a similar way and always come in pairs: every north pole is yoked to a south pole.
3. An electric current in a wire creates a circular magnetic field around the wire, its direction depending on that of the current.
4. A current is induced in a loop of wire when it is moved towards or away from a magnetic field, or a magnet is moved towards or away from it, the direction of current depending on that of the movement.

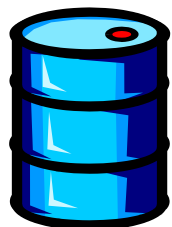
## Energy Carriers



= 14 MJ/kg



= 17 - 24 MJ/kg

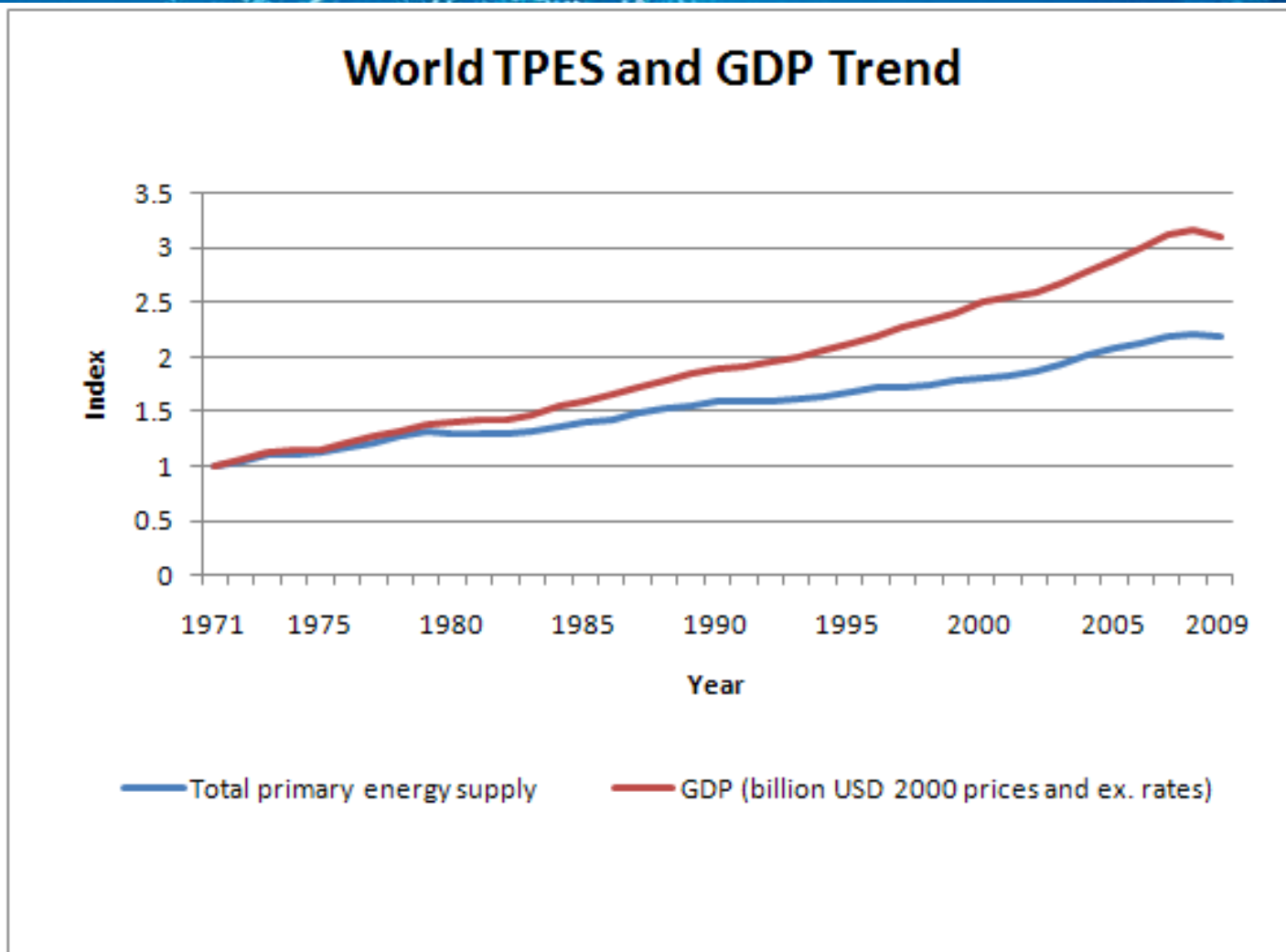


= 32 - 46 MJ/kg

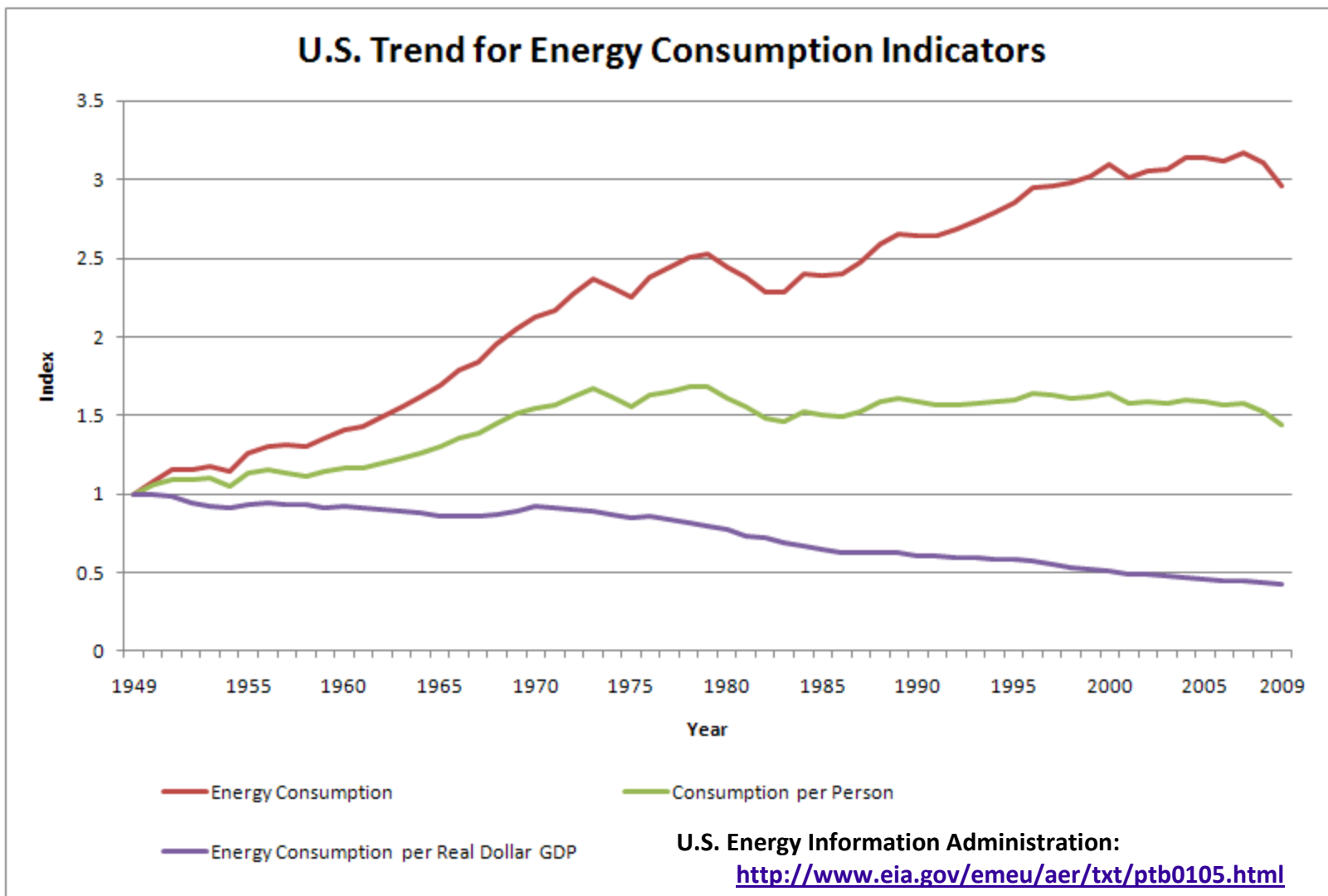


> 47 MJ/kg

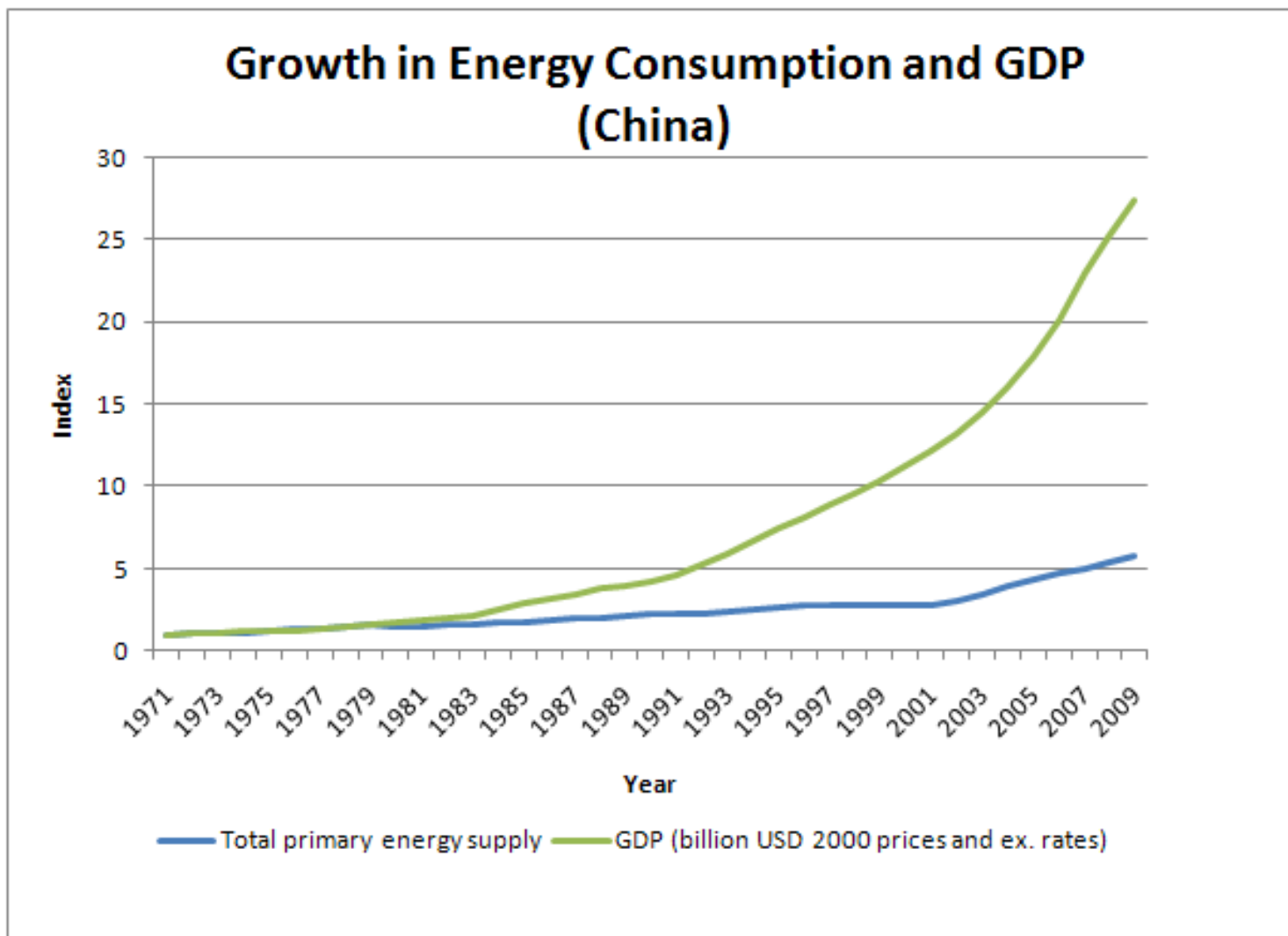
More energy  
content =  
More work  
per unit of  
mass or  
volume



Access to energy is a precursor to economic development



More value added can be extracted per unit of energy over time



In the future, the most successful economies may be the ones that can maximize this advantage



- We have learned to harness many forms of energy
- The discoveries over time have been significant and are continuing
- Energy is needed to provide useful work
- Useful work leads to both social and economic development
- 21<sup>st</sup> century economies need to track their energy use to ensure they can compete on a global scale.

**Thank you**

**[Presenter]**

**[Email address]**