Energy


I DRANK THIS STUFF CALLED "EXTREME ENERGY" AND I STAYED AWAKE FOR TWO HOURS. TWO HOURS, CLARENCE!
THAT IS EXTREME.
METZGER

Curriculum

- compare the energy consumption of contemporary society with that of traditional cultures and precontact Aboriginal societies, and investigate and analyze the exponential growth of global energy consumption in recent history
- compare Canada's **per-capita** energy consumption with developed and developing countries and identify factors that affect consumption;
- apply the concept of sustainable development to increasing the efficient use of energy;

The Currency of the Universe

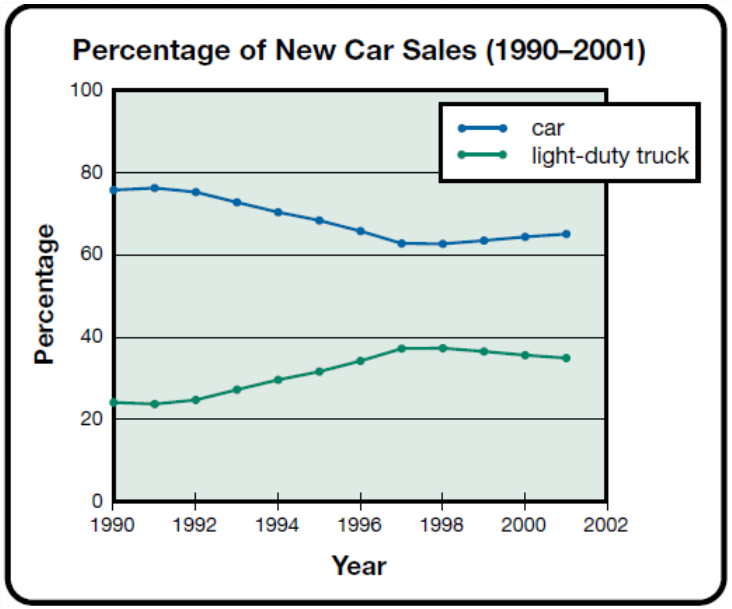
- For anything to happen energy is required
- Our own bodies require chemical potential energy in food
- Cars require chemical potential energy in fuel
- Lights in a room require electrical energy to create light energy

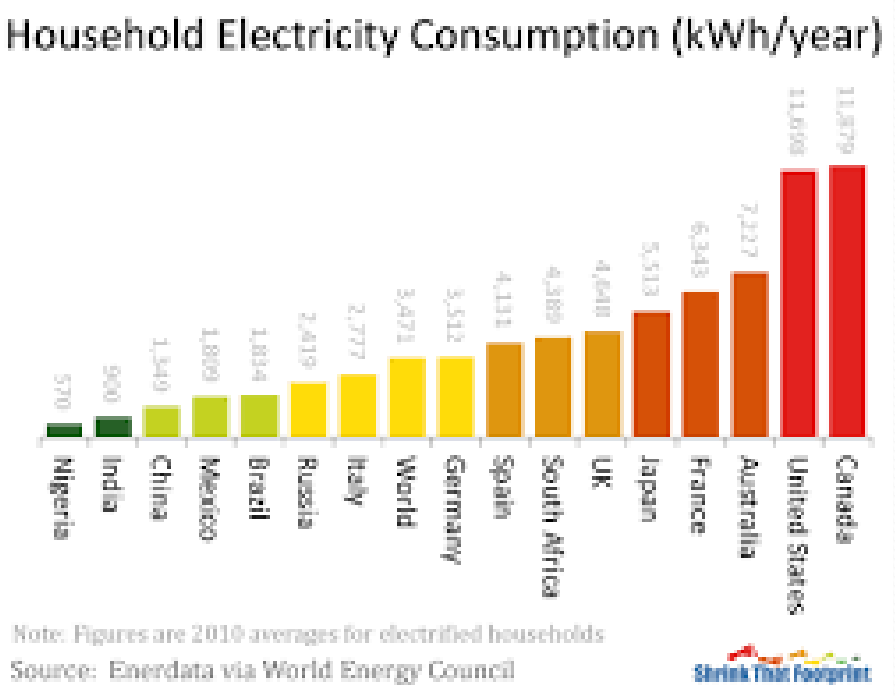
Common ways of expressing energy

Unit	Symbol	Definition	Joules Equivalent	Example of Energy Involved
joule	J	energy needed to apply a force of 1 N over a distance of 1 m	1 J	Drawing a 25-cm line with a pencil on paper requires about 1 J of energy.
	TJ	terajoule	1×10^{12} J	This is equal to the energy stored in 24 tonnes of oil.
	PJ	petajoule	1×10^{15} J	This is equal to the energy stored in 24 000 tonnes of oil.
	EJ	exajoule	1×10^{18} J	This is equal to the energy stored in 24 million tonnes of oil.
calorie	cal	energy needed to raise the temperature of 1 g of water 1°C	4.19 J	A foraging hummingbird consumes about 15 cal of energy per second.
food calorie	Cal or kcal	energy needed to raise the temperature of 1 kg of water 1°C	4190 J	A human walking 33 steps consumes an average of 1 Cal.
British thermal unit	BTU	energy needed to raise the temperature of 1 pound of water by 1°F	1054 J	A typical barbecue has an energy output of 8 BTU for each second it operates.
kilowatt-hour	kW•h	equal to the work done by one kilowatt acting for one hour	3 600 000 J	This is equal to the work done during 5 h of vigorous cycling.

Canadian Energy Use

- Our lifestyles require large usage of energy
- We tend to use more energy that we actually need per capita (per person)





Gross Domestic Product (GDP)

- Gross domestic product is the market value of all goods and services produced by a country in one year in $USD
- In 2016 Canada's was US$1.53 trillion while Kenya's was USD$ 70.53 billion
- Both countries have similar populations yet Canada's GDP is 22 times greater
- This is due to the type of industry in the countries
- Energy intensity is a measure of GDP relative to energy use

Example

- According to the student's data, what is the **energy intensity** of each country in J/trillion$US (EJ = exajoule x 10^{18})

Country	Energy Use (EJ)	GDP (trillions of US$)
Kenya	0.200	0.010
Sweden	2.22	0.300
Canada	13.80	0.753

Kenya: $(0.200 \times 10^{18}) / (0.010) = 2 \times 10^{19}$ J/trillion

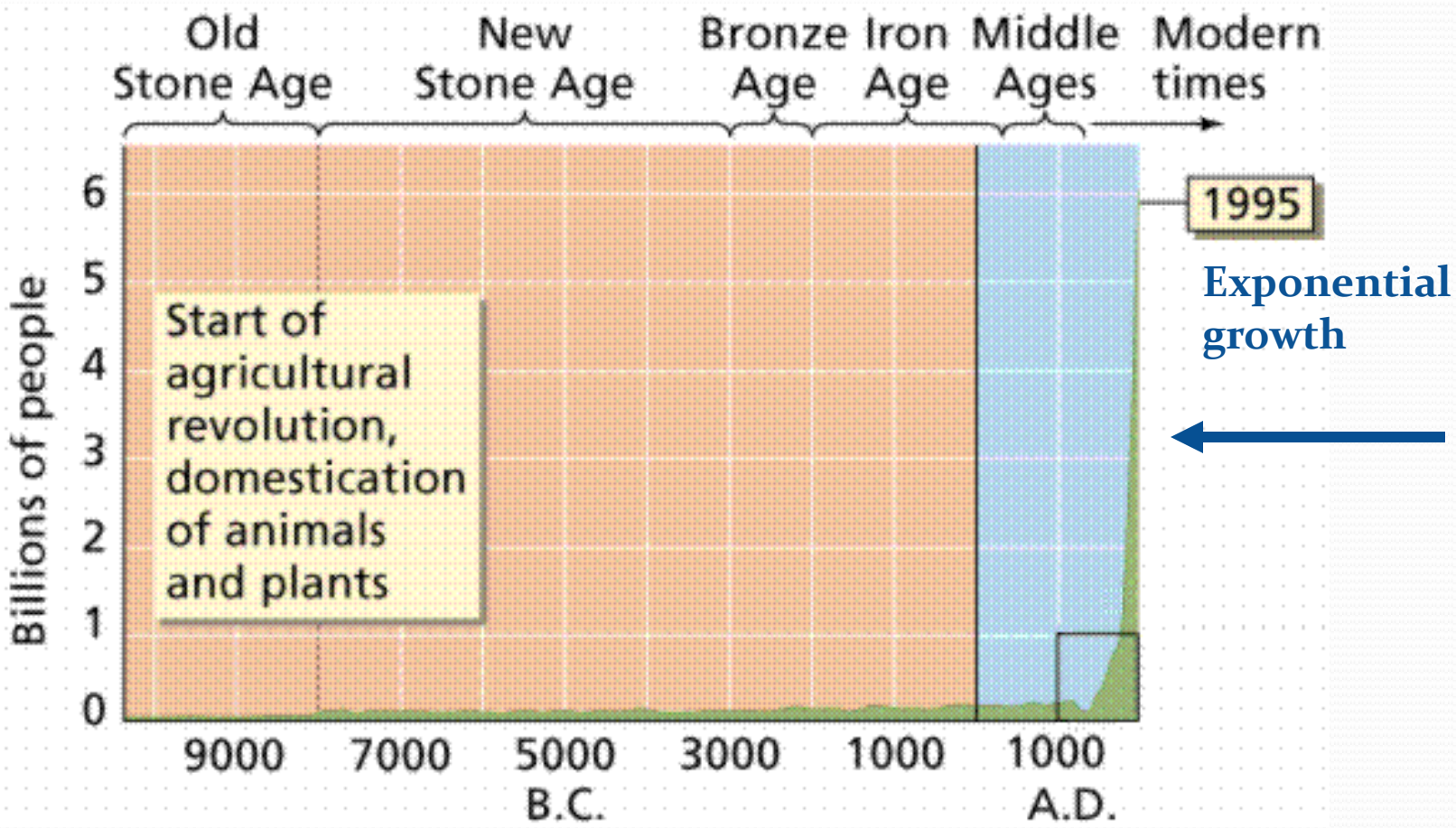
Factors Affecting Energy Usage

- Climate: extremes in temperature influence energy usage.
  - Canada = used to heat homes
  - Australia= used to cool homes
- Activity: how much a country is manufacturing
  - Measured in $, tones, km travelled.
  - AS GDP increases; activity increases; energy usage increases.

Factors Affecting Energy Usage

- Population: energy use per capita.
  - Used to measure prosperity of a country.
  - In order to become prosperous, energy use is increased= consequences for environment.
- Energy intensity: energy used/ GDP.
  - Natural resources industry requires more energy usage = higher intensity.
  - Since 1990's Canada has developed a less energy-intensive economy

Population Growth

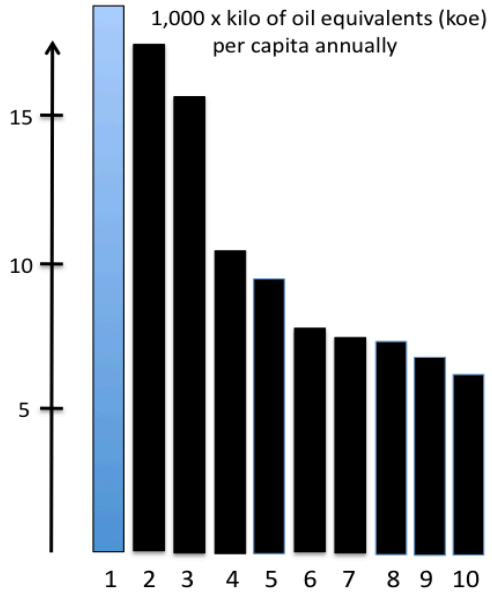


Energy Consumption

- Who do you think is the world's largest energy consumer?

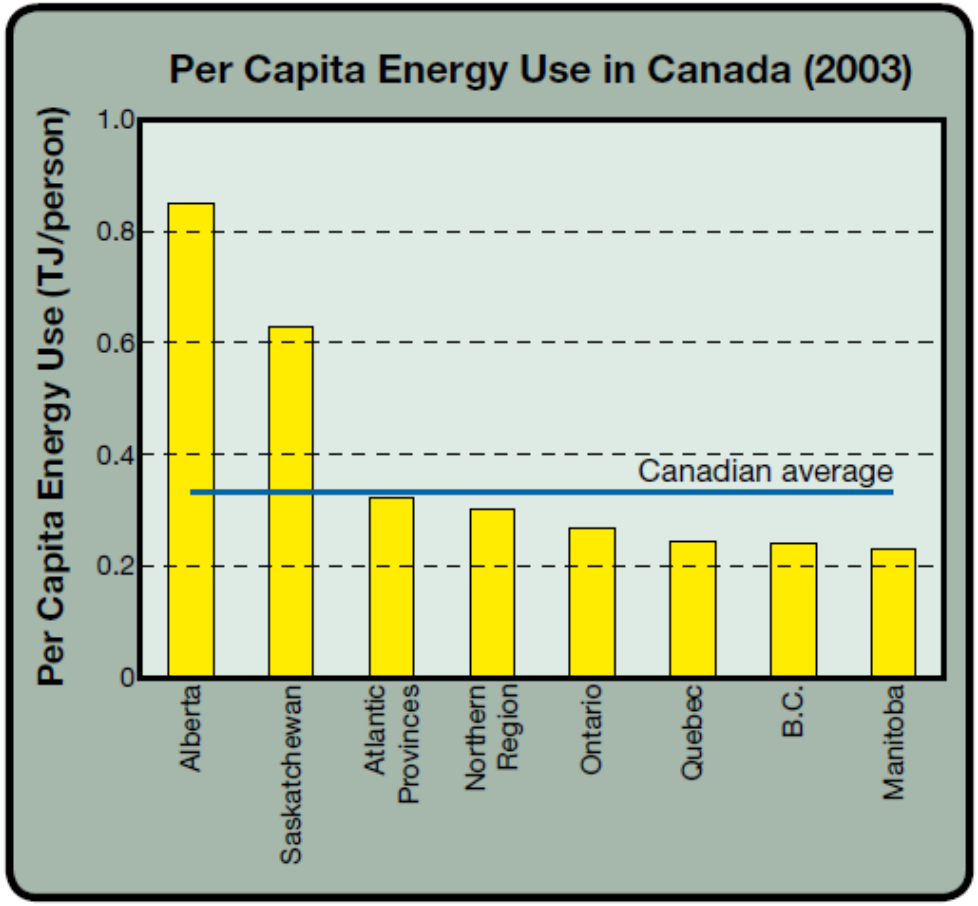
World's largest energy consuming countries per capita

1.	**Iceland**	18,774 koe
2.	Qatar	17,418 koe
3.	Trinidad	15,691 koe
4.	Kuwait	10,408 koe
5.	Brunei	9,427 koe
6.	Luxembourg	7,684 koe
7.	UAE	7,407 koe
8.	Canada	7,333 koe
9.	USA	6,793 koe
10.	Finland	6,183 koe



Source: World Bank / Oilprice.com

Alberta's Energy Usage



Energy Dissipation

- Energy cannot be created or destroyed, just transformed
- When energy is transformed, there is always a little bit lost
- Most of this lost energy is wasted as heat
- The less energy wasted as heat, the more efficient a device is
- To calculate efficiency we can use the formula:

$$efficiency = \left(\frac{output}{input}\right) \times 100\%$$

Identifying Input and Output Energy

- **Input energy** is the original type of energy delivered to your device
- **Output energy** is the goal of the device
- **Wasted energy** is all other types of energy
- What is the input, output, and wasted energy for this light bulb?

Example

- 5 J of light is produced from 100 J of electrical energy. What is the efficiency of this light bulb? How much energy is wasted?

Board Question

- Compare the devices on the chart and choose the most efficient device

Device	Input Energy	Output Energy
Mid efficiency natural gas furnace	110 kJ	85 kJ
Electric baseboard heater	9.5 kJ	9.0 kJ
Fluorescent light bulb	12.5 kJ	2.75 kJ
Battery	84.52 kJ	74.38 kJ

Ways to increase efficiency

- The most common loss of energy is when it is converted to kinetic energy
- Moving parts always create friction which produces heat so have less moving parts
- Adding insulation to devices like refrigerators or ovens can help reduce heat loss
- Using LED lights instead of incandescent bulbs