

Energy Consumption and Production Methods

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INTRODUCTION

It is well documented that the activities humans have been conducting since the Industrial Revolution have negatively impacted the environment on a global scale. In the search for energy with which to power the industry of civilization, we have caused global warming, stripped the planet of natural resources, and dumped an immeasurable amount of toxic waste into various ecosystems. Our negative impact on the planet is an unquestionably existing phenomenon that had been agreed upon by all unbiased scientific studies over the past several decades.

The question thus presents itself: where and how will we obtain the resources and energy necessary to maintain and improve industry for an ever-growing population without wrecking our own habitat?

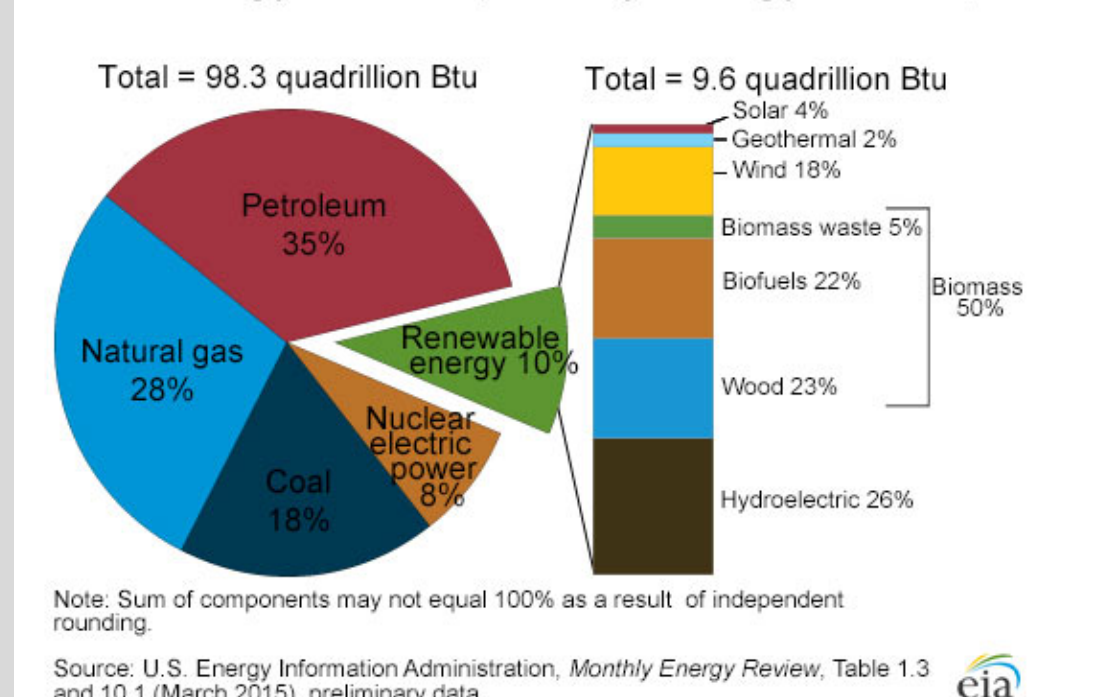
In this project, we attempted to outline several of the general problems that are faced today in the realm of energy consumption and provide possible solutions. Specifically, we addressed the technological, social/political, and economical aspects of climate change and finding alternate energy sources.

BACKGROUND

Our main sources of energy currently are the burning of carbon based fossil fuel, natural gas, and coal. Unfortunately, these are unsustainable sources of energy due to both finite resources and negative impacts on the environment, such as global warming and pollution.

Despite those who believe otherwise, the idea that humans are causing climate change is an indisputable *fact*; many (if not all) unbiased scientific studies confirm it as such. Unfortunately, fully converting to different energy sources is a difficult task – as visible in the diagram below (left), 81% of the U.S.'s energy is derived from unsustainable resources. The sheer number of factories and machinery that would need to be replaced or upgraded to provide energy from other sources is incredible – and this is only for the United States.

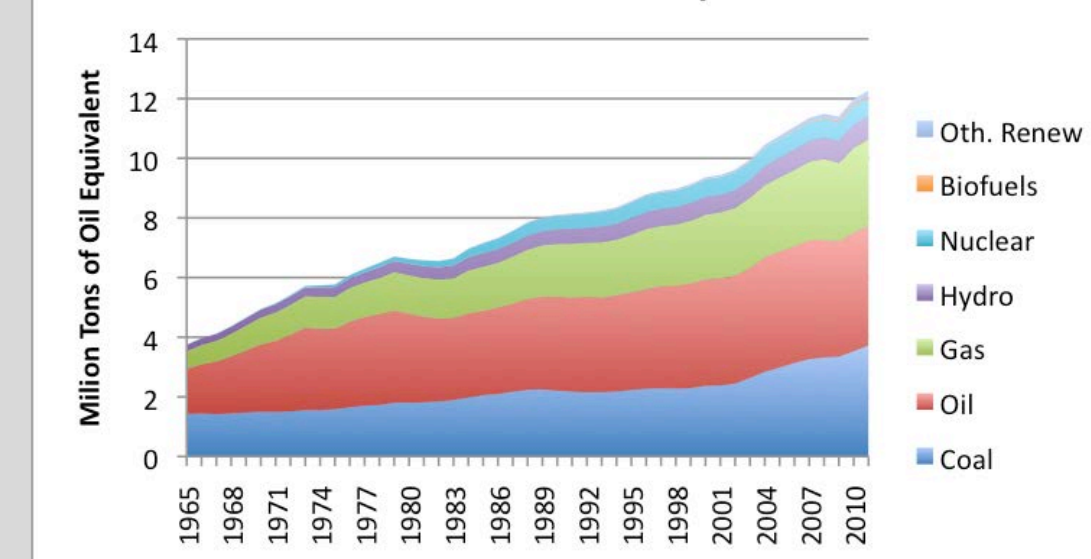
U.S. energy consumption by energy source, 2014



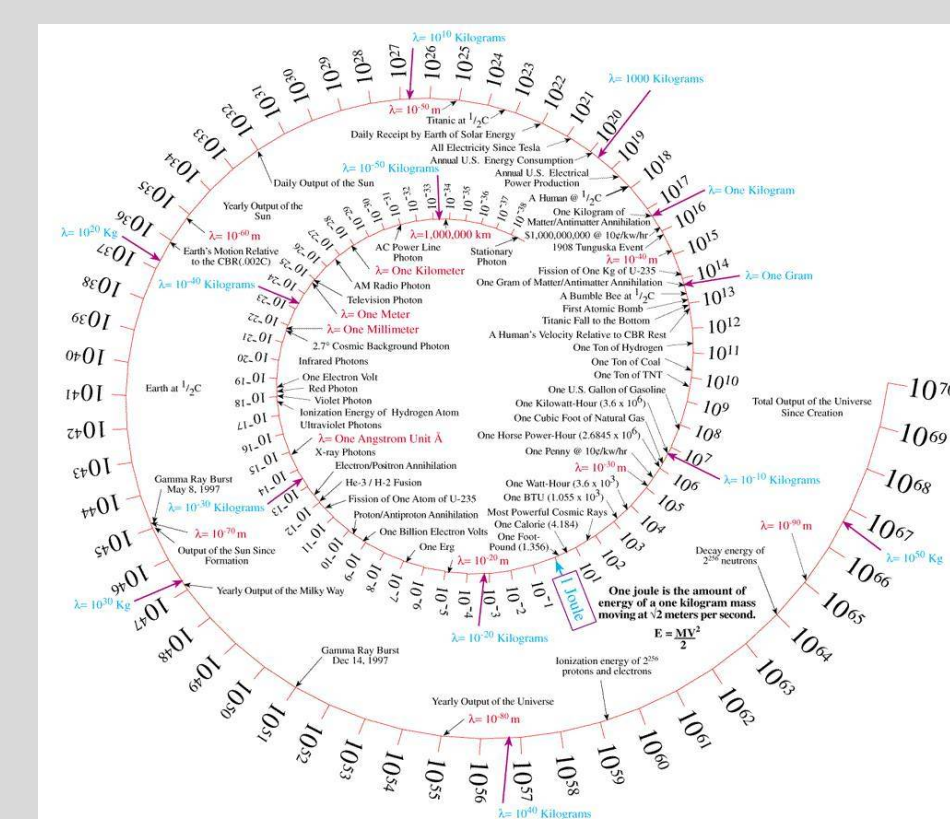
US Energy Consumption in 2014

In order to understand the problem of energy consumption, it is necessary to understand the concept of energy itself. Energy is defined as the ability to do work, and is measured in different units such as Joules (J) and Btu (British thermal units). For scale: 1 cubic foot of natural gas can contain 1,075 Btus; the US consumed 98.3 quadrillion Btus in 2014.

World Fuel Consumption



World Fuel Consumption 1965 - 2010



Energy Consumption Scale

LITERATURE CITED

"Union of Concerned Scientists." *Union of Concerned Scientists*. Union of Concerned Scientists, n.d. Web. 27 Apr. 2016. <<http://www.ucsusa.org/>>

Lecture Notes: EE 471/571 Sustainable Energy Systems, Peter Mersich, Spring 2014

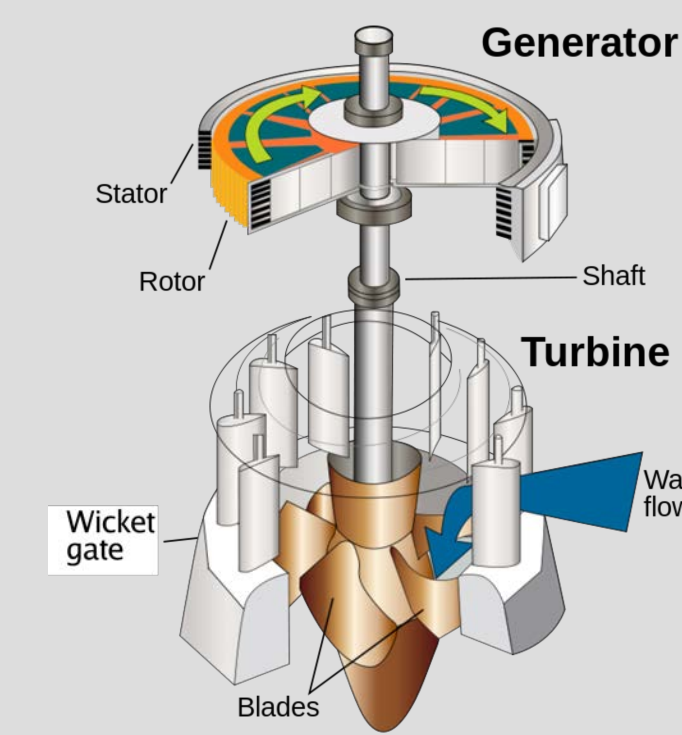
TECHNOLOGY

Renewable Energy

Renewable energy is energy taken from sources that are for all intents and purposes inexhaustible, such as the movement of air, water, and decay of plants and organisms.

Hydroelectric Power

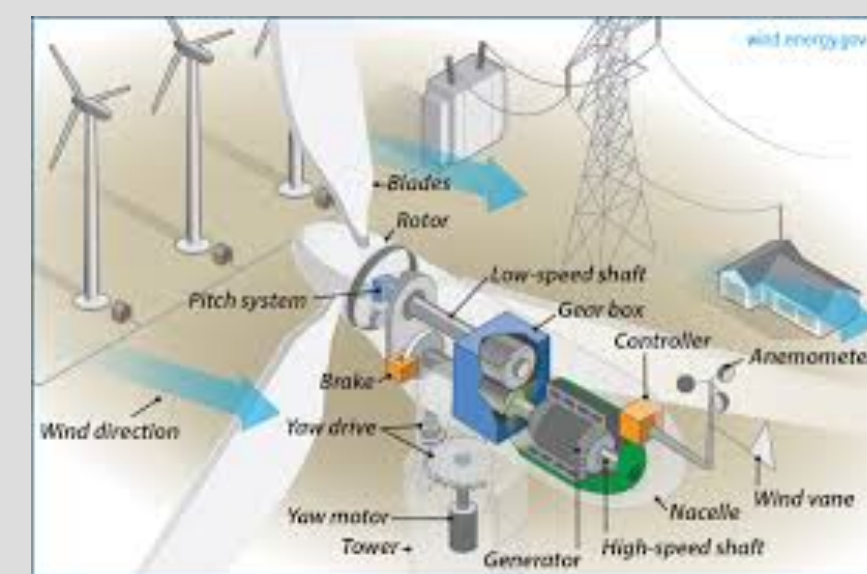
- Water rotates a propeller, which rotates a shaft, producing electricity inside a generator.
- Currently the largest source of renewable energy in the US and worldwide.
- Can be environmentally harmful due to the conditions they require, often resulting in dams that can affect ecosystems and water quality.



Water Turbine

Wind Energy

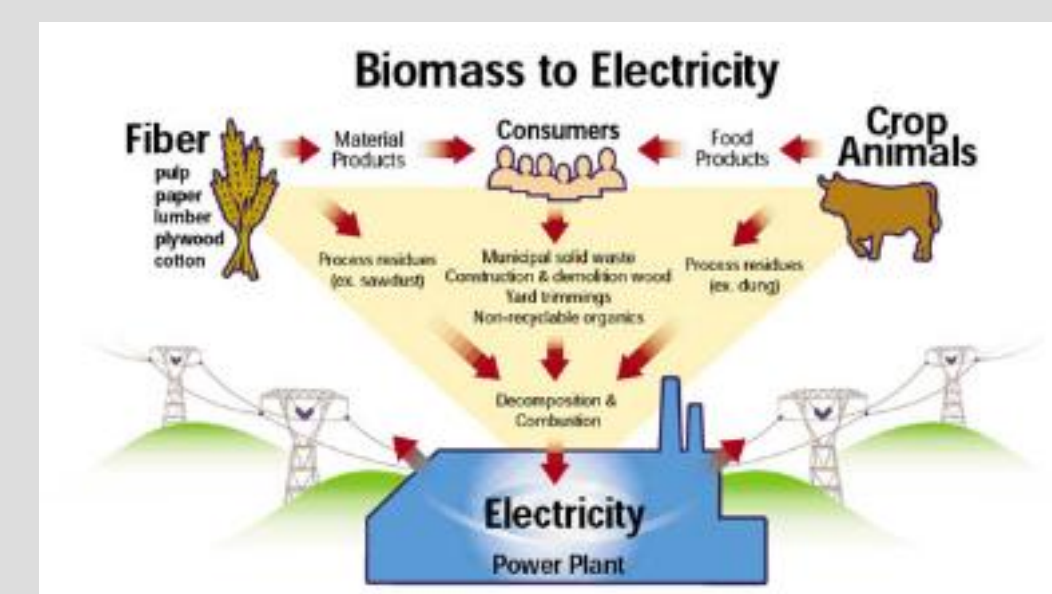
- The wind blows and rotates a fan which rotates a shaft that runs into a gearbox, which turns another shaft inside a generator, which produces electricity.
- Does not produce any waste or carbon dioxide.
- Operate under very specific conditions; only economic when the wind is blowing at a certain rate.



Wind Turbine

Biomass

- It is possible to harvest energy from plants and animal waste.
- Costly and relatively unexplored (compared to other energy sources).
- Despite being "renewable", requires large areas of land (that need to be replanted and maintained).
- Actual process could negatively impact the environment and produce the same emissions we're trying to avoid.



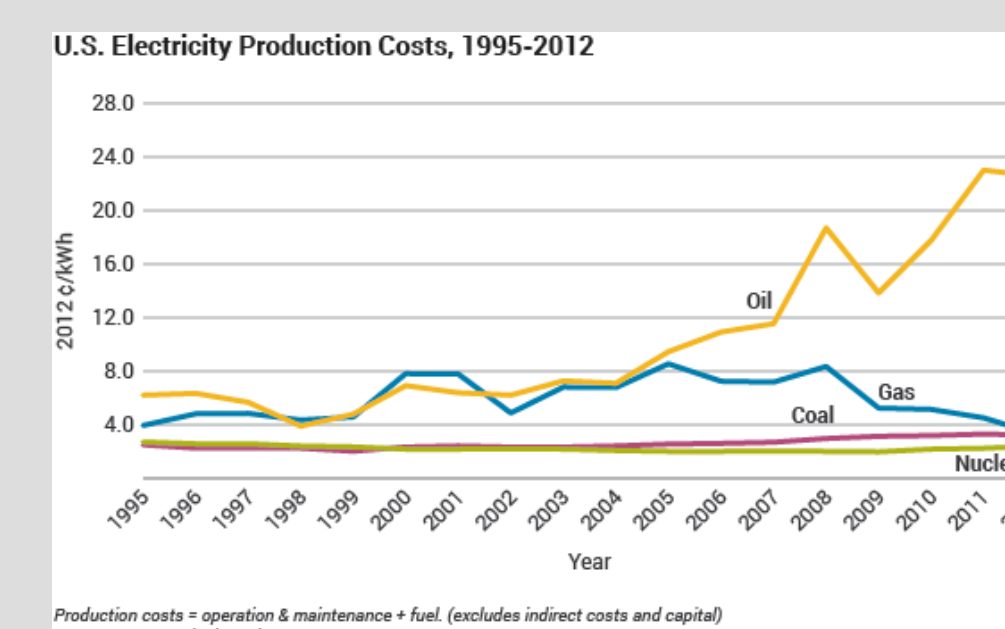
Gathering electricity from biomass

Clean Energy

Clean energy is energy whose production does not negatively impact the environment.

Nuclear

- Very cheap – comparable to cost of oil, coal burning.
- The technology for this energy source is safe, contrary to popular belief.
- Well known accidents (Fukushima, Chernobyl accidents) caused by poor planning and/or extreme circumstances.
- Creates radioactive waste, no technology to dispose of (yet).



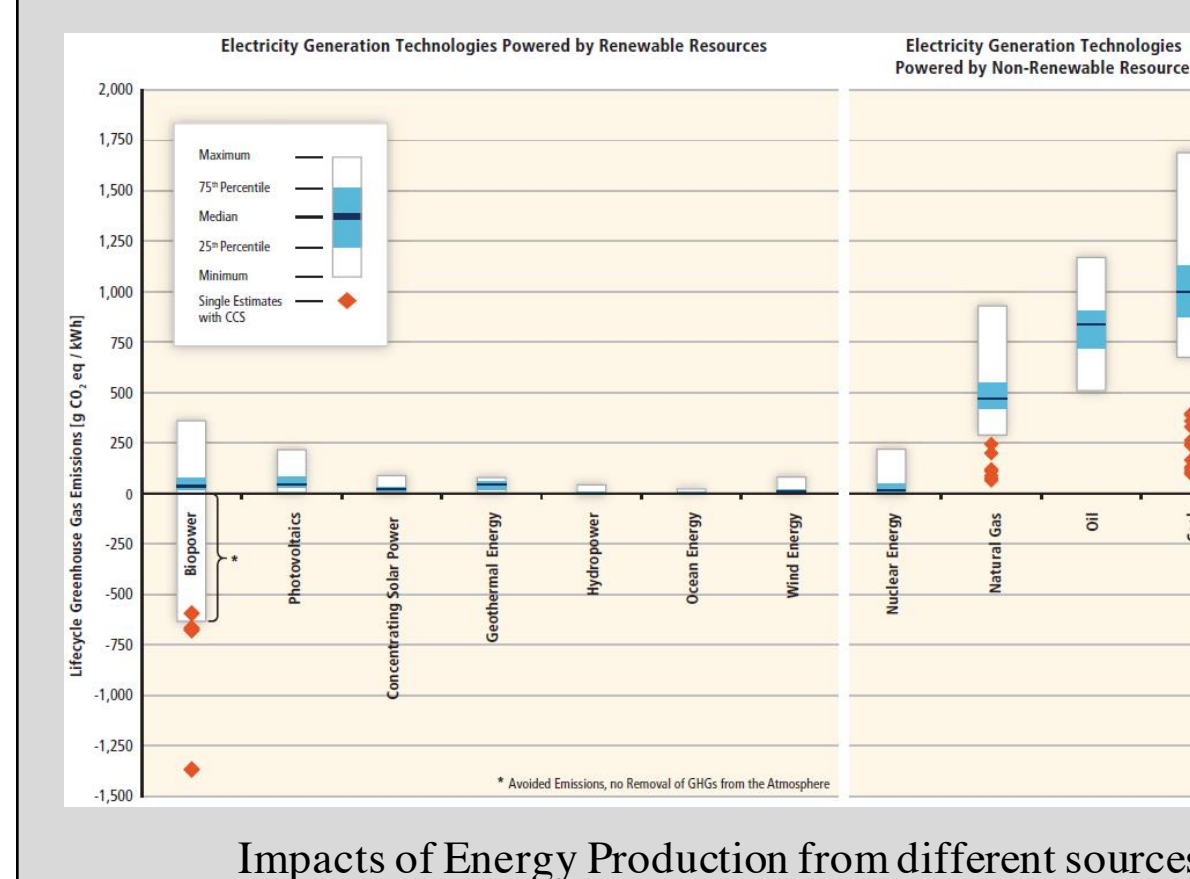
US Electricity Production Costs

POLITICAL

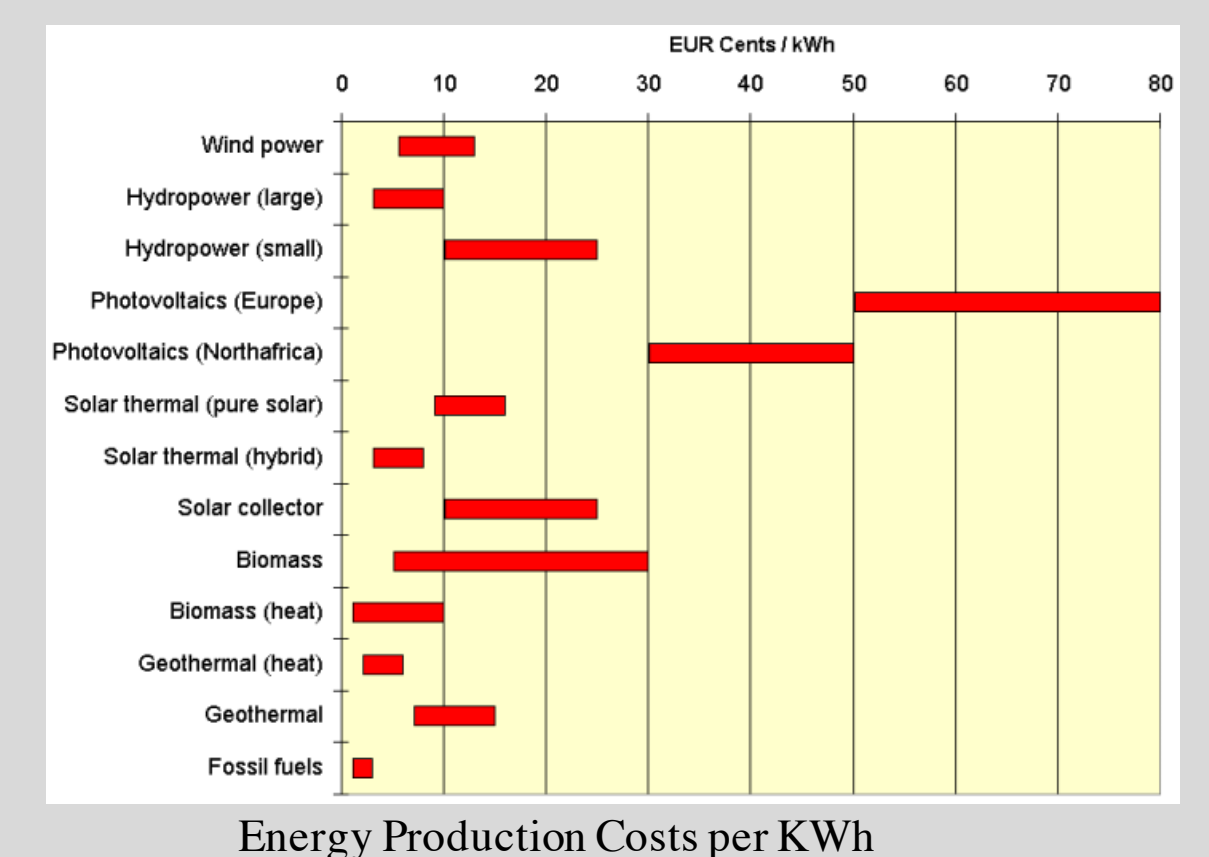
- Different countries have varying impacts on the environment, depending on size, amount of industry, and so forth.
- No amount of conversion by small countries will have an effect globally if larger industrial countries (ie. China, the US) continue to release carbon dioxide and carbon monoxide at current rates.
- In 2012, world total primary energy consumption was about 529 quadrillion British thermal units (Btu); together, the US and China were responsible for roughly 40% of this number.
- Some very efficient and cheap energy sources are illegal in certain countries.
- Many, if not most, nuclear reactors will produce some amount of weapons-grade plutonium (isotope plutonium-239) from the uranium (isotope uranium-238); weapons-grade plutonium is illegal in some countries.
- Social perception of climate change
- Some religious groups believe that it is impossible for humanity to change the Earth so drastically or that climate change is insignificant.
- There have been two major nuclear crises: Chernobyl (April 26, 1986), and Fukushima (March 12, 2011). Both were due to poor planning/preventable mistakes, especially with advances in nuclear technology
- A large number of people believe that nuclear reactors are dangerous and should not be used on a large scale to produce
- 14/27 countries in the European Union use nuclear power
- In 2014, 8% of energy produced by the US was in the form of nuclear electric power
- Ultimately, it is necessary to educate the public on the topic of climate change along with common misconceptions
- Most people simply do not realize how urgent the issue is.
- With more knowledge, more people are available to contribute ideas, money, technology.
- It is especially important to raise awareness in the younger generation – teenagers currently in high school will be responsible for fixing climate change.

ECONOMICAL

- Changing all the machinery and infrastructure in place to clean energy will inevitably cost money
- Will most likely require government subsidies
- Has the possibility to create a large number of jobs
- It is important to consider long term prices as well as up-front machinery conversion costs



Impacts of Energy Production from different sources



Energy Production Costs per KWh

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