|  |
| --- |
|  |
| How Can Alternate Energy Benefit the United States of America? |
| Global Connections |
| **Austin Alexander Sutton**  **1/23/2012**  2-B |
|  |
|  |

|  |
| --- |
|  |

Outline

1. Introduction
2. Alternate Energy Production and Overview
3. Indirect Energy Conversion
   1. Fossil Fuels
   2. Nuclear Power
   3. Wind Energy
   4. Hydropower
4. Direct Energy Conversion
5. Current Environmental Condition
6. Benefits of Alternate Energy in America
7. Conclusion

Abstract

The United States of America is in an important environmental transition where there will be no turning back. The United States of America must switch to alternate sources of energy, instead of fossil fuels, to prevent irreversible damage. Alternate energy sources can provide many benefits to the United States of America, but only if they are implemented soon. In order to learn how alternate energy sources will benefit Americans, global sources, where alternate energy is in place, must be studied. Also, predictions as to how specific energy sources will benefit the United States can be studied. The results showed that alternate energy could stabilize the decreasing population of species, which promotes biodiversity. Alternate energy also produces less pollution which is greatly needed in more populous areas in the nation. Considering these results, alternate energy sources must be implemented to save the environment, species, and humans in the country.

Introduction

“We have known for decades that our survival depends on finding new sources of energy. Yet we import more oil today than ever before,” Barack Hussein Obama demonstrates this major theme in the environmental dilemma in his Address to Joint Session of Congress.[[1]](#footnote-1) Alternate energy will have to be the future energy source of the world or the entire world will face much destruction. If nothing changes in the current production of energy, then the world will face a massive increase in greenhouse gases. This will cause a significant increase in world temperatures, which will then cause the extinction of many species of life on Earth. Therefore, the survival of many species of the world relies on the use of alternate energy and the cleansing of the environment.

How will alternate energy benefit the United States of America? Many positive environmental effects and the survival of species of plants and animals in the United States will result from using cleaner, renewable energy in America. In order to know the benefits of renewable energy, first one must know exactly how renewable energy sources work, how they differ from non-renewable energy sources, and the advantages and disadvantages of both renewable and non-renewable energy sources.

In order to recognize the benefits of alternate energy people must address the use of alternate energy to clean the environment. People must also address how the renewable energy sources can save the future of all species of life, but specifically focus on the effects in the United States of America.

Alternate Energy Production and Overview

Energy, or usable power, such as electricity, can be created in many different processes.[[2]](#footnote-2) Electrical energy is produced through a conversion process from kinetic, potential, or chemical energy. Electricity production can occur in two different processes: indirect and direct conversion. Some of these processes are cleaner than others. An energy production method is clean when it produces energy in a way that it minimizes the degradation of the environment. The use of alternate energy is a way to reduce the harmful environmental effects of energy production. Alternate energy is comprised of the energy sources that do not produce harsh undesirable effects and do not produce an abundance of harmful emissions into our atmosphere.

Indirect Energy Conversion

Indirect energy conversion is the process where energy goes from one state, to an intermediate state, then to electricity. Indirect energy processes include fossil fuels, nuclear energy, hydropower, and wind energy. These energy sources are not necessarily the least efficient even though these processes go through multiple steps to reach the state of usable electricity. However, these energy sources can be improved to try and eliminate this intermediate step. The energy efficiency levels vary from energy source to energy source and cannot be determined by whether the process is indirect or direct.

Fossil fuels are non-renewable resources that are transformed into electrical energy through an indirect energy conversion process. They are processed by burning fuel sources and changing the chemical energy into heat which then powers the steam turbines. The steam turbine then uses that chemical energy to turn the electric generators to produce kinetic energy. This kinetic energy is then transformed into electricity by these same generators. The energy conversion process of changing fossil fuels into electricity requires many different steps, which makes it lose energy and become very inefficient. Only about forty percent of the energy that comes from the initial energy source is transformed into usable electricity.

Fossil fuels are the most widely used resource for electricity production. Fossil fuels, such as petroleum, coal, and natural gas, produce harmful greenhouse gasses, such as carbon monoxide, carbon dioxide, sulfur dioxide, and nitrous oxide. These greenhouse emissions can cause holes to form in the ozone layer, which puts Earth at risk. The greenhouse effect traps solar radiation inside of the atmosphere and does not allow it to escape. This process slowly warms the surface of the Earth over long periods of time, thus causes an increase in temperature on the global scale. If the ozone layer, which blocks the ultraviolet rays from the sun, is depleted, the hole will allow ultraviolet rays to enter into the atmosphere and heat the Earth at an increased pace, which can cause inadaptable plants, animals, and humans to perish permanently. The perishing of these plants and animals can be avoided by adopting cleaner energy sources.

A more eco-friendly alternative to fossil fuels is nuclear power. Nuclear energy is a finite source and is produced through an indirect conversion process.[[3]](#footnote-3) Nuclear power contains one million times the initial energy than what is observed in fossil fuels. Therefore, this energy source has great potential to be a leading competitor against fossil fuel production. In 2007, nuclear plants produced enough energy to meet the yearly needs of sixty-two million Americans.[[4]](#footnote-4) Also, in the current year, 2011, it is producing twenty percent of the total energy in the United States.[[5]](#footnote-5) The environmental risk of partaking in nuclear power is that the pipes will be radioactive. In the event of a spill, mass amounts of radioactive material would go into the environment. Radioactive spills can severely harm humans, plants, and animals, so a nuclear spill could cause serious ramifications for all forms of life. Also, the current waste of radioactive materials goes into geological repositories, where it can sit safely until it has broken down. [[6]](#footnote-6)

An example of the dangers of nuclear meltdowns and other disasters is Chernobyl in what is now Ukraine. Chernobyl is the site where nuclear reactor four exploded on April 26, 1986. The workers and the surrounding citizens were affected by it. This meltdown caused approximately thirty people to die almost immediately, but the situation has since affected hundreds, if not thousands. The radiation from the explosion caused cancer in many people, especially children. The nuclear fallout created a radius of nineteen miles that was uninhabitable due to the threat of radiation sickness. [[7]](#footnote-7)

Nuclear energy is produced through a fission reaction by cutting the nucleus of an atom from a heavy element, such as Uranium, in half. The heat produced by this fission reaction gives power to a steam turbine which turns the electric generator and then produces the electricity that powers the homes and satisfies the needs of people.

Another way to produce electricity is the use of wind energy. This energy source has a maximum efficiency of almost sixty percent, but the average efficiency percentage is around forty. This source of energy is not too reliable, though, because it requires a constant wind speed of twenty kilometers per hour. Wind energy produces the same amount of final product energy as fossil fuels. Although unreliable, it can save the world from the environmentally taxing effects of fossil fuels, such as global warming and pollution.

Wind energy is an indirect energy conversion process the initial energy comes from the sun. The solar radiation causes the air over land to heat up faster because of the low evaporation and the fact that land does not absorb a great amount of heat. The air over water, on the other hand, absorbs more heat and causes water to evaporate, which makes the air above it cooler. After this happens, the air above the land rises and the air above the water moves in to land to take that air’s place which causes wind. At night the air above the land cools faster, causing the air to move towards the water. The air above the water stays warm longer which causes it to rise and then the land air takes its spot. The wind turbine then uses this air, produced by solar radiation, to convert the kinetic energy into circular motion around a shaft which then is turned into electricity. [[8]](#footnote-8)

There are very few disadvantages with these wind energy production systems. There are the aesthetically displeasing looks, the effects on the bird populations, and the land requirements that the wind turbines need. One way to combat the first disadvantage of their unsightly looks is to place them in remote areas, such as on the mountain tops and in oceans. This is also a requirement of the functionality because wind turbines require a constant speed of twenty kilometers per hour, which can be satisfied in windy oceans, mountain tops, and plains. The wind turbines affect the bird populations because the migratory patterns sometimes coincide with the placement of turbines and the birds can be killed. Research is still being done as to how to make these wind turbines safer for the bird populations. [[9]](#footnote-9)

Hydroelectric power is also a safe bet for future energy production. There are many ecological and economic benefits to using this kind of power source. The techniques of harnessing power from water do not pollute the air, land, or water and hydroelectric systems are also inexpensive. To combat the problem of fish not being able to reach their spawning grounds, fish ladders have been added to the design of dams. Fish ladders are flowing man-made locks that the migratory fish can jump onto and reach the upstream or downstream side. Hydropower is the only renewable source of energy that can replace fossil fuels and still meet energy needs for the near future. Hydropower is cleaner, more efficient, and better for the environment than fossil fuels. Another benefit for the community is that hydropower creates a reservoir that can be used for recreation. The reservoirs can be used for recreation because the lake that forms above the dam can be used for swimming, boating, and sometimes fishing.[[10]](#footnote-10)

Hydroelectric power is also an indirect conversion process because it uses the sun as a part in the hydrological cycle. The sun evaporates the water and then precipitates the water down atop a mountain which then flows down the mountain and through a hydroelectric plant.[[11]](#footnote-11) When the water flows through the hydraulic turbine the kinetic energy turns an electric generator which produces the usable electricity.

Direct Energy Conversion

Direct energy conversion is another process that is used to change the source of the energy into usable electricity. This energy conversion process uses no intermediate steps to change the initial source into electricity. Solar radiation, which is a renewable source of energy, is converted into electricity through the direct energy conversion process using photovoltaic cells.

Photovoltaic cells are used in the generation of electricity by capturing the solar radiation in a semiconductor-covered multijunction solar cell.[[12]](#footnote-12) This process of direct energy conversion has recently achieved an efficacy of twelve percent which is double what it was in the past. This is a great achievement in solar power’s progress towards the road to replacing the need for fossil fuels because these types of photovoltaic cells are cheap, lightweight, environmentally friendly, and now are becoming more efficient. [[13]](#footnote-13)

Current Environmental Condition

America is at a crucial time where the future will forever be changed by actions made towards the environmental conditions of today. The future health of Americans lay in the hands of today’s citizens and policymakers. If nothing is changed about the misuse of natural resources and the excessive waste produced, the future will suffer tremendously.

The United States of America, as a developed country, has more accessibility to natural resources. This allows its citizens to be wasteful in their actions that degrade the environment and use up the resources. Some of the environmentally degrading actions that the citizens of the United States of America take are: driving their automobiles in excess, heating and cooling their homes in times that don’t require heating and cooling, and the need for massive production of energy.

The activities in which Americans participate release pollution into the waterways, air, and land. These actions also increase the temperature ever so slightly, but in the long run these temperature increases will show terrible results. The levels of greenhouse gases, which are top contributors to climate increase, are higher than what the levels were expected to be just four years ago. In 2007, climate experts had estimated that by the end of the century the world average temperature would increase about seven degrees Fahrenheit. Although this sounds insignificant and the climate experts sound too overdramatic, these increases will play a huge role in the next century.[[14]](#footnote-14)

Increases in temperature can cause numerous changes to the earth and all of the species on the earth. James Randerson, the science correspondent on the Guardian newspaper team, says, “even at three degrees rise, you’re talking about twenty to fifty percent of species facing extinction.” Also, a rise in overall temperatures can cause coastal flooding in some areas of the world and major droughts in drier, hotter areas. [[15]](#footnote-15)

The trend of global warming can potentially put thousands of species into extinction in the next few decades if nothing is done to prevent it. The oceans are acidifying, which means that carbon dioxide is being released into the oceans from the burning of fossil fuels. After the level of carbon dioxide in the water reaches a certain level, or when it hits the zone of intolerance, many fish and other aquatic species can die. The zone of intolerance is the highest level of a condition before the species starts to die from that condition. Also temperature increases affect the coral reef habitats because coral reefs are very sensitive to changes in their habitat. When the ocean temperature rises, coral reefs start to bleach by shedding the algae that feeds them. Once the coral reefs start to bleach, the animals that dwell in the coral reefs die because their habitat has been destroyed.[[16]](#footnote-16)[[17]](#footnote-17)

Benefits of Alternate Energy in America

There are numerous benefits from renewable energy that can alter the ecological conditions of the United States of America. America is a nation that focuses its livelihood and prosperity around the extensive use of natural resources. Americans overuse all of the natural resources by relying on fossil fuels and other non-renewable sources of energy, so switching to alternate energy sources brings about many beneficial changes. In his Address to the Nation, President Jimmy Carter addressed this topic:

“Ours is the most wasteful nation on Earth. We waste more energy than we import. With about the same standard of living, we use twice as much energy per person as do other countries like Germany, Japan, and Sweden.”[[18]](#footnote-18)

Michael Grunwald also addresses this waste of energy in “Wasting Watts”:

“This may sound too good to be true, but the U.S. has a renewable-energy resource that is perfectly clean, remarkably cheap, surprisingly abundant and immediately available. It has astounding potential to reduce the carbon emissions that threaten our planet, the dependence on foreign oil that threatens our security and the energy costs that threaten our wallets. Unlike coal and petroleum, it doesn't pollute; unlike solar and wind, it doesn't depend on the weather; unlike ethanol, it doesn't accelerate deforestation or inflate food prices; unlike nuclear plants, it doesn't raise uncomfortable questions about meltdowns or terrorist attacks or radioactive-waste storage, and it doesn't take a decade to build. It isn't what-if like hydrogen, clean coal and tidal power; it's already proven to be workable, scalable and cost-effective. And we don't need to import it. This miracle juice goes by the distinctly boring name of energy efficiency, and it's often ignored in the hubbub over alternative fuels, the nuclear renaissance, T. Boone Pickens and the green-tech economy. Clearly, it needs an agent. But it's a simple concept: wasting less energy.”[[19]](#footnote-19)

Biodiversity is an important part of life on earth because it ensures the livelihood of all species. All species of life in a community are interdependent and connected. Therefore if one species died out, then all species would be affected. If all of the flies in a community died out, then all of the species of frogs, who were dependent on flies for food, now either have to emigrate or die. Also, as Emily Garritson said in her paper regarding the Costa Rican golden toads, “the population [of Costa Rican golden toads] could foreshadow similar crashes in other populations and aid in isolating the factors triggering the quick declines.”[[20]](#footnote-20)[[21]](#footnote-21)

Clean air is also another valuable resource that comes from switching to alternate energy. This is of importance to the United States because it will ensure the biodiversity of communities. When the air is polluted, many species of animals suffer from various effects. In 1948, the town of Donora, Pennsylvania experienced a serious air pollution incident. The air was polluted extremely and there was a thick layer of smog in the air. The residents began to immediately see the effects of the heavy smog on farm animals and pets. The smog only lasted a week in the city, but the animals grew very sick and some even died during this time. Had the smog lasted longer, the city could have very easily started to notice signs in not only their animals, but also their economy, which was based around the production of animal products.[[22]](#footnote-22)

Clean air is also a sign that there are not high levels of greenhouse gases in the air, which deplete the ozone layer and increase the planet’s overall temperature. Increasing the overall temperature of the air is a huge problem that will increase in the next century. One species that has been widely affected by this global temperature increase are the Costa Rican golden toads. The Costa Rican golden toads are a species that has recently gone extinct due to the rise of temperatures. Approximately thirty years ago scientists discovered the Costa Rican golden toad and now they have gone extinct. This really baffled the scientists until the documents on weather patterns were analyzed. The temperature rise apparently made the golden toad become extinct in such a short time. The temperature reached the golden toad’s zone of intolerance and then it no longer was able to survive.

Alternate energy sources are very environmentally-friendly when it comes to the levels of air quality. Many sources of alternate energy, such as hydropower, solar power, and wind power produce emit virtually no toxins into the atmosphere. These types of alternate energy sources should be constructed in regions in the United States because there are many problem areas with high levels of air pollutants. Some of these areas that suffer from air pollution can be found in Figure 1.[[23]](#footnote-23)

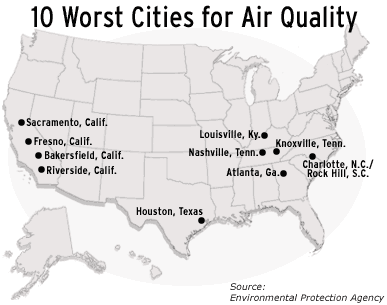


Figure 1

Alternate energy sources are also very ecologically-friendly in the sense of water quality. Wind energy and solar energy are the two most ecologically friendly because they produce neither pollution nor interference with water systems. The only reason that the wind turbines could affect water systems is if the turbines were placed in the water. This would result in the disruption of habitats such as that of the coral reefs. With hydropower the water systems are affected in that the dams trap sediments on the upstream side which causes plants and animals on the downstream side to die. Also, migratory fish that swim upstream have to accustom themselves to swimming in the fish ladders that are implemented in the dams. The problem with nuclear power in the water systems is that if the nuclear plant, that is located in proximity of a source of water, explodes and then the nuclear waste will irradiate that water. This irradiated water will then kill all the fish and other forms of life there.

Conclusion

The use of renewable energy will have to start now, so that in the future alternate energy will have a strong basis and so that alternate energy will take over the use of fossil fuels. The main frontrunner energy sources in the transition from non-renewable, environmentally harmful fuels sources are wind, solar, water, and nuclear energy. These all have their drawbacks, but those do not even compare to the consequences of using fossil fuels. Benefits that the United States of America and all of its citizens will receive are the sanctity of life of humans, plants, and animals; the access to water and air that is free of or has reduced levels of pollution and toxins.

In the next few decades global temperatures will continue to rise and an extinction of certain specialist species will occur. This trend will level out once the environmentally friendly energy sources take over the environmentally harmful ones. This could possibly take a bit of time, but in the long run it would be worth it.

The ultimate question now is whether or not the United States will follow the path of alternate energy or if the country will follow the path that leads to the destruction of the environment. Jimmy Carter explains this through his Speech to the Nation:

“We are at a turning point in our history. There are two paths to choose. One is a path I've warned about tonight, the path that leads to fragmentation and self-interest. Down that road lies a mistaken idea of freedom, the right to grasp for ourselves some advantage over others. That path would be one of constant conflict between narrow interests ending in chaos and immobility. It is a certain route to failure. All the traditions of our past, all the lessons of our heritage, all the promises of our future point to another path, the path of common purpose and the restoration of American values. That path leads to true freedom for our nation and ourselves. We can take the first steps down that path as we begin to solve our energy problem.”[[24]](#footnote-24)

Works Cited

"10 Worst Cities for Air Quality." Map. CBS News. N.p., n.d. Web. 19 Dec. 2011. <http://www.cbsnews.com/htdocs/dirty\_air/framesource\_worst\_cities.html>.

Barack Hussein. "Address to Joint Session of Congress." 24 Feb. 2009. Quotations on Energy/Alternatives. Web. 19 Dec. 2011. <http://www.stthomas.edu/recycle/energy.htm>.

Barnes, R.S.K., and Mann, K.H. (1991). Fundamentals of Aquatic Ecology. Blackwell Publishing. pp. 217–227. ISBN 0632029838. Retrieved 2008-11-26.

The Boston Globe. "Chernobyl disaster 25th anniversary." The Big Picture. N.p., 25 Apr. 2011. Web. 19 Dec. 2011. <http://www.boston.com/bigpicture/2011/04/chernobyl\_disaster\_25th\_annive.html>. Obama,

Barack Hussein. "Address to Joint Session of Congress." 24 Feb. 2009. Quotations on Energy/Alternatives. Web. 19 Dec. 2011. <http://www.stthomas.edu/recycle/energy.htm>.

Carter, Jimmy. "Address to the Nation." University of St. Thomas. Quotations on Energy/Alternatives. Web. 19 Dec. 2011. <http://www.stthomas.edu/recycle/energy.htm>.

Carter, Jimmy. "Speech to the Nation." University of St. Thomas. 15 July 1979. Quotations on Energy/Alternatives. Web. 19 Dec. 2011. <http://www.stthomas.edu/recycle/energy.htm>.

Catcott, E. J. "Effects of Air Pollution on Animals." N.d. World Health Organization. Web. 19 Dec.2011. <http://whqlibdoc.who.int/monograph/WHO\_MONO\_46\_(p221).pdf>.

"Energy." Def. 4. Merriam-Webster's Collegiate Dictionary. N.p., 2011. Web. 2 Dec. 2011. <http://www.merriam-webster.com/dictionary/energy?show=0&t=1322543119>.

Environmental Defense Fund. "Climate Change Impacts." What We Do. N.p., n.d. Web. 19 Dec. 2011. <http://www.edf.org/climate/climate-change-impacts>.Ewing, Rodney C. Nuclear Fuel Cycle: Environmental Impact. University of Michigan, Apr. 2008. Web. 2 Dec. 2011.

Garritson, Emily. "Where O' Where Did the Golden Toads Go?" 16 May 2008. Miami University. Web. 19 Dec. 2011. <http://jrscience.wcp.muohio.edu/fieldcourses06/PapersCostaRicaArticles/ Final.WhereOWhereDidtheGo.html>.

The Guardian. "Greenhouse gases rise by record amount." Environment. N.p., 3 Nov. 2011. Web. 19 Dec. 2011. <http://www.guardian.co.uk/environment/2011/nov/04/greenhouse-gases-rise-record-levels>.

Kim, Jin Young, et al. New Architecture for High-Efficiency Polymer Photovoltaic Cells. 572-573. Massachussetes Institute of Technology, 2006. Web. 2 Dec. 2011. <http://web.mit.edu/kjhuang/www/Literature/Solar%20Cells/Experimental/Fullerene/High%20Impact/New%20architecture%20for%20high%20efficiency%20polymer%20PV.pdf>.

Knier, Gil. "How do Photovoltaics Work? ." NASA Science News. NASA, 6 Apr. 2011. Web. 2 Dec. 2011. <http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells/>.

Middlebury College. "Wind Energy." Wind Power. N.p., n.d. Web. 19 Dec. 2011. <http://cr.middlebury.edu/es/altenergylife/windpower.htm>.

Miller, G. Tyler, and Scott E. Spoolman. Living in the Environment. Illus. Patrick Lane, ScEYEence Studios, and Rachel Ciemma. Ed. Christopher Delgado and Lauren Oliveira. 16th ed. Belmont:Brooks/Cole, 2007. Print.

Nuclear Energy Institute. "Operating at 98% Efficiency, U.S. Nuclear Plants Play Vital Role in Beating Sweltering Heat Wave." News and Events. N.p., 2011. Web. 19 Dec. 2011. <http://www.nei.org/newsandevents/newsreleases/operatingat/>.

Randerson, James. "Climate change: 'We're talking about massive shifts in the Earth's systems.'" The Guardian. 7 Aug. 2008. The Guardian/Observer Archive. Web. 19 Dec. 2011. <http://www.guardian.co.uk/environment/audio/2008/aug/07/ james.randerson.climate.change.bob.watson>.

Shah, Anup. "Why Is Biodiversity Important? Who Cares?" Global Issues. N.p., 6 Apr. 2011. Web. 19 Dec. 2011. <http://www.globalissues.org/article/170/ why-is-biodiversity-important-who-cares#WhyisBiodiversityImportant>.

Virginia Polytechnic Institute. "Sources of Energy." Virginia Tech Education Modules. N.p., 2007. Web. 2 Dec. 2011. <http://www.dg.history.vt.edu/ch2/sources.html>.

"The Water Cycle." Chart. The Water Cycle - Water Science for Schools. U.S. Geological Survey, 30 Nov. 2011. Web. 2 Dec. 2011. <http://ga.water.usgs.gov/edu/watercycle.html>.

Virginia Polytechnic Institute. "Sources of Energy." Virginia Tech Education Modules. N.p., 2007. Web. 2 Dec. 2011. <http://www.dg.history.vt.edu/ch2/sources.html>.

World Nuclear Association. Nuclear Power in the USA. N.p., Dec. 2011. Web. 19 Dec. 2011. <http://www.world-nuclear.org/info/inf41.html>.

1. Obama, Barack Hussein. "Address to Joint Session of Congress." 24 Feb. 2009. *Quotations on Energy/Alternatives*. Web. 19 Dec. 2011. <http://www.stthomas.edu/recycle/energy.htm>. [↑](#footnote-ref-1)
2. "Energy." Def. 4. *Merriam-Webster's Collegiate Dictionary*. N.p., 2011. Web. 2 Dec. 2011. <http://www.merriam-webster.com/dictionary/energy?show=0&t=1322543119>. [↑](#footnote-ref-2)
3. Virginia Polytechnic Institute. "Sources of Energy." *Virginia Tech Education Modules*. N.p., 2007. Web. 2 Dec. 2011. <http://www.dg.history.vt.edu/ch2/sources.html>. [↑](#footnote-ref-3)
4. Nuclear Energy Institute. "Operating at 98% Efficiency, U.S. Nuclear Plants Play Vital Role in Beating Sweltering Heat Wave." *News and Events*. N.p., 2011. Web. 19 Dec. 2011. <http://www.nei.org/newsandevents/newsreleases/operatingat/>. [↑](#footnote-ref-4)
5. World Nuclear Association. Nuclear Power in the USA. N.p., Dec. 2011. Web. 19 Dec. 2011. <http://www.world-nuclear.org/info/inf41.html>. [↑](#footnote-ref-5)
6. Ewing, Rodney C. *Nuclear Fuel Cycle: Environmental Impact*. University of Michigan, Apr. 2008. Web. 2 Dec. 2011. [↑](#footnote-ref-6)
7. The Boston Globe. "Chernobyl disaster 25th anniversary." The Big Picture. N.p., 25 Apr. 2011. Web. 19 Dec. 2011. <http://www.boston.com/bigpicture/2011/04/chernobyl\_disaster\_25th\_annive.html>. [↑](#footnote-ref-7)
8. Virginia Polytechnic Institute. "Sources of Energy." *Virginia Tech Education Modules*. N.p., 2007. Web. 2 Dec. 2011. <http://www.dg.history.vt.edu/ch2/sources.html>. [↑](#footnote-ref-8)
9. Middlebury College. "Wind Energy." Wind Power. N.p., n.d. Web. 19 Dec. 2011. <http://cr.middlebury.edu/es/altenergylife/windpower.htm>. [↑](#footnote-ref-9)
10. Miller, G. Tyler, and Scott E. Spoolman. *Living in the Environment*. Illus. Patrick Lane, ScEYEence Studios, and Rachel Ciemma. Ed. Christopher Delgado and Lauren Oliveira. 16th ed. Belmont:Brooks/Cole, 2007. Print. [↑](#footnote-ref-10)
11. "The Water Cycle." Chart. *The Water Cycle - Water Science for Schools*. U.S. Geological Survey, 30 Nov. 2011. Web. 2 Dec. 2011. <http://ga.water.usgs.gov/edu/watercycle.html>. [↑](#footnote-ref-11)
12. Knier, Gil. "How do Photovoltaics Work?." *NASA Science News*. NASA, 6 Apr. 2011. Web. 2 Dec. 2011. <http://science.nasa.gov/science-news/science-at-nasa/2002/solarcells/>. [↑](#footnote-ref-12)
13. Kim, Jin Young, et al. *New Architecture for High-Efficiency Polymer Photovoltaic Cells*. 572-573. Massachussetes Institute of Technology, 2006. Web. 2 Dec. 2011. <http://web.mit.edu/kjhuang/www/Literature/Solar%20Cells/Experimental/Fullerene/High%20Impact/New%20architecture%20for%20high%20efficiency%20polymer%20PV.pdf>. [↑](#footnote-ref-13)
14. The Guardian. "Greenhouse gases rise by record amount." Environment. N.p., 3 Nov. 2011. Web. 19 Dec. 2011. <http://www.guardian.co.uk/environment/2011/nov/04/greenhouse-gases-rise-record-levels>. [↑](#footnote-ref-14)
15. Randerson, James. "Climate change: 'We're talking about massive shifts in the Earth's systems.'" The Guardian. 7 Aug. 2008. The Guardian/Observer Archive. Web. 19 Dec. 2011. <http://www.guardian.co.uk/environment/audio/2008/aug/07/ james.randerson.climate.change.bob.watson>. [↑](#footnote-ref-15)
16. Barnes, R.S.K., and Mann, K.H. (1991). Fundamentals of Aquatic Ecology. Blackwell Publishing. pp. 217–227. ISBN 0632029838. Retrieved 2008-11-26. [↑](#footnote-ref-16)
17. Environmental Defense Fund. "Climate Change Impacts." What We Do. N.p., n.d. Web. 19 Dec. 2011. <http://www.edf.org/climate/climate-change-impacts>. [↑](#footnote-ref-17)
18. Carter, Jimmy. "Address to the Nation." University of St. Thomas. Quotations on Energy/Alternatives. Web. 19 Dec. 2011. <http://www.stthomas.edu/recycle/energy.htm>. [↑](#footnote-ref-18)
19. Grunwald, Michael. "America's Untapped Energy Resource: Boosting Efficiency." *Time Magazine*. N.p., 2012. Web. 19 Dec. 2011. <http://www.time.com/time/magazine/article/0,9171,1869224,00.html>. [↑](#footnote-ref-19)
20. Garritson, Emily. "Where O' Where Did the Golden Toads Go?" 16 May 2008. Miami University. Web. 19 Dec. 2011. <http://jrscience.wcp.muohio.edu/fieldcourses06/PapersCostaRicaArticles/ Final.WhereOWhereDidtheGo.html>. [↑](#footnote-ref-20)
21. Shah, Anup. "Why Is Biodiversity Important? Who Cares?" Global Issues. N.p., 6 Apr. 2011. Web. 19 Dec. 2011. <http://www.globalissues.org/article/170/ why-is-biodiversity-important-who-cares#WhyisBiodiversityImportant>. [↑](#footnote-ref-21)
22. Catcott, E. J. "Effects of Air Pollution on Animals." N.d. World Health Organization. Web. 19 Dec.2011. <http://whqlibdoc.who.int/monograph/WHO\_MONO\_46\_(p221).pdf>. [↑](#footnote-ref-22)
23. "10 Worst Cities for Air Quality." Map. CBS News. N.p., n.d. Web. 19 Dec. 2011. <http://www.cbsnews.com/htdocs/dirty\_air/framesource\_worst\_cities.html>. [↑](#footnote-ref-23)
24. Carter, Jimmy. "Speech to the Nation." University of St. Thomas. 15 July 1979. Quotations on Energy/Alternatives. Web. 19 Dec. 2011. <http://www.stthomas.edu/recycle/energy.htm>. [↑](#footnote-ref-24)