A Content Secondary Science Newsletter from the
Southern Nevada Regional Professional Development Program

Science Dissected

Nuclear Energy
Model-Evidence Link Diagram (MEL)

Energy is an essential ingredient in meeting one's basic needs and in stimulating and supporting economic growth. Our standard of living is often associated with our ability to produce the energy needed by people. Meeting those energy needs is becoming more difficult..

Nuclear Energy is one energy source used that often generates strong feelings in people. This issue of Science Dissected provides an instructional resource for teachers to present students with the opportunity to examine several pieces of evidence complied about Nuclear Energy and critically evaluate two competing models. This MEL was developed to be used in an honors or AP level class.

Model A: Nuclear Energy has a minimal impact on the environment and on natural resources.

Model B: Nuclear energy has a large impact on the environment and on natural resources.

Evidence #1: According to the Nuclear energy Institute, nuclear energy has a low carbon footprint.

Evidence #2: Nuclear power plants produce no air pollution or carbon dioxide, but they do produce byproducts like nuclear waste and spent fuels.

Evidence #3: Environmental impact of nuclear energy must include the entire "nuclear fuel cycle."

Evidence #4: Nuclear plants have the largest workforce annual income based on both large capacity and being a labor-intensive technology.

The following is a suggestion for using this MEL with students:

1. Hand out the Nuclear Energy Model Evidence Link Diagram (page 1). Instruct students to read the directions, descriptions of Model A and Model B, and the four evidence texts presented.
2. Handout the four evidence text pages (pages 3-17).
3. Instruct students to carefully review the Evidence #1 text page (page 3), then construct two lines from Evidence #1; one to Model A and one to Model B. Remind students that the shape of the arrow they draw indicates their plausibility judgment (potential truthfulness) connection to the model.
4. Repeat for Evidence #2-4 (pages 5-17).
5. Handout page 2 for the students to critically evaluate their links and construct understanding.

Once students have completed page 2, they can then engage in collaborative argumentation as they compare their links and explanations with that of their peers. Students should be given the opportunity to revise the link weighting during the collaborative argumentation exercise. If time permits, have students reflect on their understanding of nuclear energy and create questions that they might explore in the future.

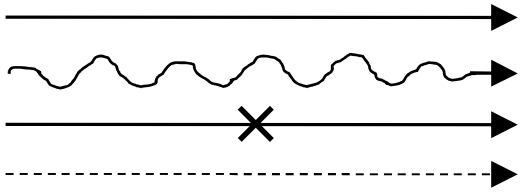
Archived Issues of Science Dissected, *http://www.rpdp.net/link.news.php?type=sciencedis*. ***Instructional Resource resulting from Plausibility, It's All About Connecting the Models Workshop co-sponsored by CPDD and SNRPDP Science March 6, 2012***

Written by: Mary Shane

Name:_____ _____ **Period:**_____

Directions: draw two arrows from each evidence box. One to each model. You will draw a total of 8 arrows.

Key:



The evidence **supports** the model

The evidence **STRONGLY supports** the model

The evidence **contradicts** the model (shows its wrong)

The evidence has **nothing to do with** the model

Standard: P.12.C.4

Evidence #1
According to the Nuclear Energy Institute, nuclear energy has low carbon footprint.

Model A
Nuclear Energy has a minimal impact on the environment and on natural resources

Evidence #3
Environmental impact of Nuclear Energy must include the entire "nuclear fuel cycle."

Evidence #2
Nuclear power plants produce no air pollution or carbon dioxide, but they do produce byproducts like nuclear waste and spent fuels.

Model B
Nuclear Energy has a large impact on the environment and on natural resources.

Evidence #4
Nuclear plants employ the largest workforce annual income based on both large capacity and being a labor-intensive technology.

Provide a reason for three of the arrows you have drawn. **Write your reasons for the three most interesting or important arrows.**

A. Write the number of the evidence you are writing about.
B. Circle the appropriate descriptor (**strongly supports | supports | contradicts | has nothing to do with**).
C. Write the letter of the model you are writing about.
D. Then write your reason.

1. Evidence # ____ strongly supports | supports | contradicts | has nothing to do with Model _____ because:

2. Evidence # ____ strongly supports | supports | contradicts | has nothing to do with Model _____ because:

3. Evidence # ____ strongly supports | supports | contradicts | has nothing to do with Model _____ because:

4. Circle the plausibility of each model. [Make two circles. One for each model.]

	Greatly implausible (or even impossible)									Highly Plausible
Model A	1	2	3	4	5	6	7	8	9	10
Model B	1	2	3	4	5	6	7	8	9	10

5. Circle the model which you think is correct. [Only circle one choice below.]

Very certain that Model A is correct	Somewhat certain that Model A is correct	Uncertain if Model A or B is correct	Somewhat certain that Model B is correct	Very certain that Model B is correct

Evidence #1: According to the Nuclear Energy Institute, nuclear energy has low carbon footprint.

NEI: Nuclear Energy Institute

QUOTABLE:

"Victory in the war against climate change is inconceivable without nuclear power. … Clean, efficient, safe nuclear energy could force enormous savings in carbon dioxide emissions."

- Jonah Goldberg, Los Angeles Times column, May 13, 2008

About NEI

NEI Helps the Environment by Reducing Its Carbon Footprint

To improve its environmental stewardship, the Nuclear Energy Institute in 2008 joined The Climate Registry as a founding reporter, agreeing to voluntarily measure and publicly report its greenhouse gas (GHG) emissions each year.

Working with First Environment, a consulting firm that provides GHG emissions inventory support, NEI reports its carbon footprint—or total GHG emissions—annually and then takes actions to reduce that footprint. The GHG measurements are documented using The Climate Registry's general reporting protocol and independently verified. Because all reporters use the same methodologies, representing best practice in voluntary corporate reporting of GHG emissions, the reported information is an accurate, consistent, high-quality data set of GHG emissions.

In reporting its carbon footprint, NEI strives to lead by example by fully assessing ways in which its employees and buildings can use less energy. For example, NEI's 2009 greenhouse gas emissions reported to the Climate Registry included emissions of 675 metric tons of CO_2-equivalent. NEI reduced its greenhouse gas emissions by more than 12 percent from the 769 metric tons of CO_2-equivalent reported in 2008.

The report has been verified as accurate by Advanced Waste Management Systems Inc.

In 2008-2009, NEI took the following actions to reduce its carbon footprint going forward:

• Remodeled main office areas incorporating efficient lighting and insulation
• Built-out new Capitol Hill conference center in a LEED-certified manner.

Other companies in the nuclear energy industry have also joined The Climate Registry, including

Arizona Public Service Co., Duke Energy, Pacific Gas and Electric, Progress Energy, SCANA and Xcel Energy. Nuclear energy provides the largest amount of carbon-free electricity, which helps the nation meet its growing electricity needs while reducing the effects of climate change. Read more about nuclear energy's environmental benefits.

http://www.nei.org/aboutnei/nei-helps-the-environment-by-reducing-its-carbon-footprint

Evidence #2: Nuclear power plants produce no air pollution or carbon dioxide, but they do produce byproducts like nuclear waste and spent fuels.

Our partner, the Lance Armstrong Foundation fights to improve the lives of people affected by cancer.

ENVIRONMENTAL IMPACTS OF NUCLEAR ENERGY

0COMMENTS
Sep 2, 2010 | By Dani Alexis Ryskamp

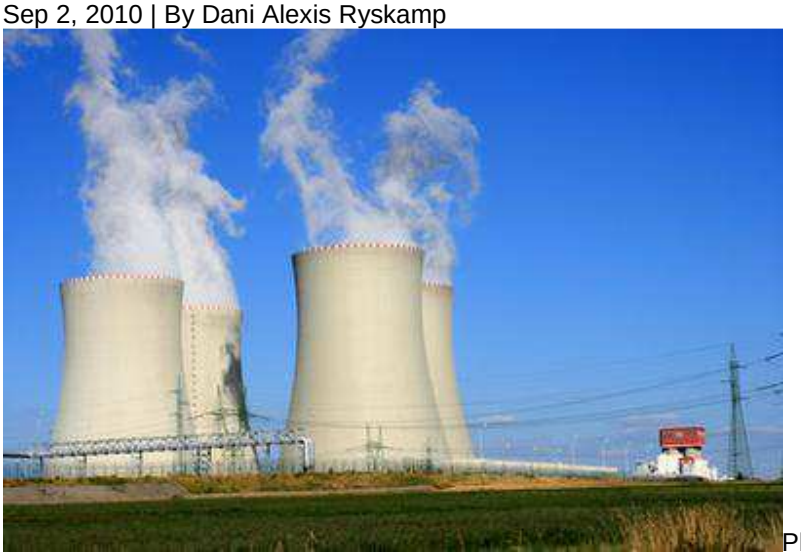


Photo Credit nuclear power station 5 image by Vitezslav Halamka from Fotolia.com

Nuclear energy power plants are usually fueled with uranium, a naturally-occurring element found in several places, including the United States, Canada, Australia and South Africa. Uranium is refined and then put through a nuclear fusion process that releases energy, but also reduces the uranium to plutonium, a highly toxic and radioactive element. In a nuclear plant, the energy released is used to boil water, which turns a turbine that creates electricity. Nuclear energy has many well-known environmental impacts.

Air Pollution

Nuclear energy is often referred to as "clean" energy because it does not release the same air pollutants as traditional power plants. However, according to Power Scorecard nuclear plants may release small amounts of radioactive gases, including carbon-14 and iodine-131. Also, the mining process required to locate uranium and the refining process to make it useful to nuclear power plants both require electricity. This electricity is usually produced by traditional power plants, which continue to emit greenhouse gases.

Water Pollution

Water pollution from nuclear plants falls into one of two categories, non-radioactive and radioactive, according to Nuclear Tourist. Non-radioactive water pollution results from the plant's use of water in its cooling towers and in the steam generators that turn the plant's turbines to create electricity. This water may be treated for various chemicals and discharged into a river, stream or lake, or it may be re-routed and used again in the plant. Water polluted with radioactive waste must be carefully controlled by the plant, and testing must show that it is not dangerous to living things before it can be discharged. The Nuclear Regulatory Commission enforces strict consequences against nuclear plants that discharge radioactive water.

Solid Waste Pollution

Like most power plants, nuclear power plants produce solid waste. Solid waste that is not radioactive is disposed of in ordinary landfills, where it may pollute soil, air or groundwater as it breaks down. Radioactive waste is disposed of in one of two ways. Items that have been made radioactive by plant exposure, such as tools, clothing and equipment, are compacted into barrels and buried in landfills specially designed for this waste, according to Nuclear Tourist. Spent radioactive fuel is either buried deep underground or is re-processed into mixed oxide fuel and re-used.

References

- Power Scorecard: Electricity from Nuclear Power
- Nuclear Tourist: Environmental Effects of Nuclear Power
- A.S. Paschoa: Environmental Effects of Nuclear Power Generation

Article reviewed by JPC Last updated on: Sep 2, 2010

http://www.livestrong.com/article/217899-environmental-impacts-of-nuclear-energy/

Nuclear Energy

Electricity from Nuclear Energy

Nuclear energy originates from the splitting of uranium atoms in a process called fission. Fission releases energy that can be used to make steam, which is used in a turbine to generate electricity. Nuclear power accounts for approximately 20 percent of the United States' electricity production. More than 100 nuclear generating units are currently in operation in the United States.[1]

Uranium is a nonrenewable resource that cannot be replenished on a human time scale. Uranium is extracted from the earth through traditional mining techniques or chemical leaching. Once mined, the uranium ore is sent to a processing plant to be concentrated into enriched fuel (i.e., uranium oxide pellets). Enriched fuel is then transported to the nuclear power plant.

In the plant's nuclear reactor, neutrons from uranium atoms collide with each other, releasing heat and neutrons in a chain reaction. This heat is used to generate steam, which powers a turbine to generate electricity. Nuclear power generates a number of radioactive by-products, including tritium, cesium, krypton, neptunium and forms of iodine.

Environmental Impacts

Although power plants are regulated by federal and state laws to protect human health and the environment, there is a wide variation of environmental impacts associated with power generation technologies.

The purpose of the following section is to give consumers a better idea of the specific air, water, land, and radioactive waste releases associated with nuclear power electricity generation.

Air Emissions

Nuclear power plants do not emit carbon dioxide, sulfur dioxide, or nitrogen oxides as part of the power generation process. However, fossil fuel emissions are associated with the uranium mining and uranium enrichment process as well as the transport of the uranium fuel to and from the nuclear plant.

Water Resource Use

Nuclear power plants use large quantities of water for steam production and for cooling. Some nuclear power plants remove large quantities of water from a lake or river, which could affect fish and other aquatic life.

Water Discharges

Heavy metals and salts build up in the water used in all power plant systems, including nuclear ones. These water pollutants, as well as the higher temperature of the water discharged from the power plant, can negatively affect water quality and aquatic life. Nuclear power plants sometimes discharge small amounts of tritium and other radioactive elements as allowed by their individual wastewater permits.

Waste generated from uranium mining operations and rainwater runoff can contaminate groundwater and surface water resources with heavy metals and traces of radioactive uranium.

Spent Fuel

Every 18 to 24 months, nuclear power plants must shut down to remove and replace the "spent" uranium fuel.[2] This spent fuel has released most of its energy as a result of the fission process and has become radioactive waste.

Currently, the spent fuel is stored at the nuclear plants at which it is generated, either in steel-lined, concrete vaults filled with water or in above-ground steel or steel-reinforced concrete containers with steel inner canisters. In 2012, the President's *Blue Ribbon Commission on America's Nuclear Future* issued a report (PDF) (180 pp., 4.3M, About PDF) recommending the timely development of one or more permanent deep geological facilities for the safe disposal of spent fuel.

Radioactive Waste Generation

Enrichment of uranium ore into fuel and the operation of nuclear power plants generate wastes that contain low-levels of radioactivity. These wastes are shipped to a few specially designed and licensed disposal sites.

When a nuclear power plant is closed, some equipment and structural materials become radioactive wastes. This type of radioactive waste is currently being stored at the closed plants until and appropriate disposal site is opened.

Management, packaging, transport, and disposal of waste are strictly regulated and carefully controlled by the U.S. Nuclear Regulatory Commission and the U.S. Department of Transportation.

Reserves

In 2008, U.S. uranium ore reserves were estimated at one billion, 227 million pounds. These reserves are located primarily in Wyoming and New Mexico.[3]

1. U.S. Department of Energy, Energy Information Administration, Energy in Brief, April 22, 2011.
2. U.S. Department of Energy, Energy Information Agency, Nuclear Power Generation and Fuel Cycle Report 1997 (PDF) (118 pp., 1M, About PDF).
3. U.S. Department of Energy, Energy Information Administration, U.S. Uranium Reserves Estimates, July 2010.

Last updated on Wednesday, February 29, 2012

http://www.epa.gov/cleanenergy/energy-and-you/affect/nuclear.html

Environmental Impact

Building a Sustainable Future

Now more than ever, Duke Energy has a responsibility to produce and deliver energy to our customers that's reliable, affordable and increasingly clean.

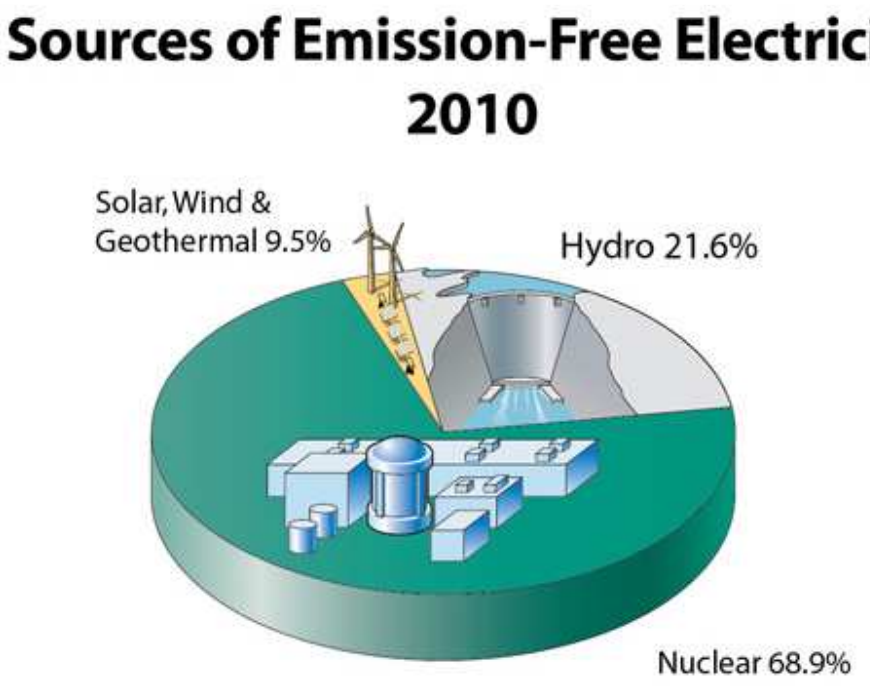
That's where sustainability comes in. We believe sustainability means doing business in a way that is good for people, the planet and profits. And as one of the largest electric service providers in the U.S., we know our operations have an impact on the environment.

We're working to reduce our eco-footprint by upgrading environmental controls at many of our fossil fuel-powered generation plants; pursuing the development of new nuclear stations; investing heavily in renewable energy and smart grid technology; and pioneering new programs and offers to help our customers become more energy efficient.

For a closer look at our progress to becoming a more sustainable company, please visit our Sustainability page.

Did you know?
Nuclear energy is the only large-scale, clean-air electricity source that can be expanded widely to produce large amounts of energy.

A key aspect of Duke Energy's sustainability success is our safe, reliable and efficient plant operations. The average capacity factor for our nuclear fleet – a measure of reliability – has remained at greater than 90 percent for the past 10 years.



Source: U.S. Energy Information Administration

Did you know?
Each year, year, nuclear energy prevents the emission of 650 million metric tons of carbon dioxide — nearly as much CO2 as is released from all U.S. passenger cars — by taking the place of fossil fueled electricity that otherwise would be used.

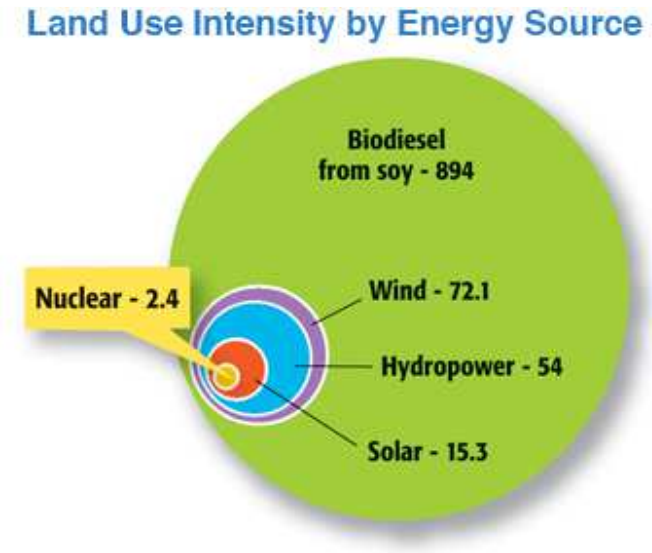
In 1970, the United States government took action to reduce air pollutants and greenhouse gases by passing the Clean Air Act. The act established strict guidelines for the particulate and gaseous emissions of U.S. power plants and industrial facilities. The first nuclear plants began producing electricity in 1973 and have steadily contributed to the reduction of greenhouse gas emissions ever since.

Reduce, Reuse and Recycle!

- Producing no carbon dioxide, sulfur dioxide or nitrogen dioxide, nuclear energy reduces greenhouse gas emissions by substituting for fossil fuels that otherwise would have been burned to generate electricity.
- Since work began at the Lee Nuclear site, we have reused 63,725 cubic yards of concrete for crusher-run in road beds, as well as riprap around site ponds.
- Duke Energy has recycled 6,200 gross tons of steel from old buildings demolished during the Lee Nuclear site preparation for reuse.

Did you know?
Nuclear energy energy has the lowest impact to natural habitat of any energy source. A typical nuclear plant takes up 1.5 square miles in area.

The Nature Conservancy released a study on land use for new energy production and reported that nuclear energy uses the least land per unit of energy generated.



The values represent estimated energy production by nuclear and renewable energy sources in 2030, measured in km2 of affected area per terawatt-hour produced in that year. By this measure, coal is 9.7, natural gas 18.6, and petroleum 44.7. (Source: Nuclear Energy Institute)

http://www.duke-energy.com/about-us/nuclear-environmental-impact.asp

Evidence #3: Environmental impact of Nuclear Energy must include the entire “nuclear fuel cycle.”

http://www.altenergy.org/nonrenewables/nuclear_impacts.html

Nuclear Impacts

Generating nuclear power appears to be an effective way to create dangerous waste garbage that cannot be safely thrown away, though often is. Past operations have resulted in contamination and fatalities throughout almost every step of the mining, refining, and disposal process. Even now we have no idea how to safeguard future generations from radioactive material used to produce today's electricity. Yet we continue to rely on it to provide over 17% of our world's energy.

Uranium is distributed unevenly throughout the world. About 80% is located in six countries with only 9 companies accounting for 82% of uranium production. Canada and Australia supply 34% and over 15%, respectively, of the world's supply. Over 440 reactors worldwide process the uranium for electricity.

The process begins in the mines**.** To supply an average plant (1000 MWe) with one year's worth of uranium, 45,000-90,000 tons of low-grade uranium ore are dug from surface or underground mines in order to extract a meager 25 tons of enriched uranium to be used in a nuclear reactor core. Uranium usually composes less than 1% of the total material mined, so the rock that encases it winds up littering the landscape in the form of radioactive tailings. In the US , radioactive tailings make up "over 95 percent of the volume of all radioactive waste from all stages of the nuclear weapons and power production" process.

The people who work at these uranium mines and plants live with the constant threat of radioactive contamination in their clothes, on their skin, and in the air they breathe. Even alpha radiation, the least dangerous of the three types (alpha, beta, and gamma), can eventually kill someone if they inhale particles containing it. Improper disposal of radioactive tailings is also an issue that affects nearby communities. Mill tailings have been responsible for most of the radioactive environmental contamination that has occurred in the last few decades. In the US , "nearly one third of all mill tailings from abandoned mill operations are on lands of the Navajo nation alone. Many Native Americans have died of lung cancers linked to their work in uranium mines. Others continue to suffer the effects of land and water contamination due to seepage and spills from tailings piles." This radioactivity will likely affect other people who go near the area for hundreds or thousands of years. Nuclear power therefore concerns everyone, since the poison it leaves behind does not just go away in a few months.

Once rock containing uranium has been whittled down to 25 tons and the tailings discarded, it must be enriched for use in modern reactors. The naturally occurring 0.7% ratio of the isotope uranium-235 must be increased to about 3.5%. First it is converted into a gas. Then the isotope uranium-238 is extracted, wasting 87% of the material in order to retrieve the

desired 13% of U-235-enriched uranium. This uranium dioxide is converted into powder and compacted into pellets, which are put into fuel rods and inserted into the reactor.

In the recent past, some of the 87% of the so-called "depleted" uranium "was used by the US military to fabricate armor-piercing conventional weapons and tank armor plating." Armed forces personnel were not informed of their exposure to radioactive material, nor were there procedures for measuring doses.
The enriched 13% that enters the nuclear reactor core undergoes fission and causes a chain reaction. Heat boils water and steam drives a turbine and an electric generator capable of providing about 7 billion kilowatt-hours of electricity annually.

After the enriched uranium is used, 97% of it goes back into the reactor to be reprocessed with fresh uranium. About 200 tons of enriched uranium is needed to keep a plant going but only 25 tons of fresh fuel are added each year. "The remaining 3%, about 700 kg, is high-level radioactive waste which is potentially hazardous and needs to be isolated from the environment for a very long time." While in the reactor, some of the U-238 turns into plutonium and fission products. These are even more dangerous and deadly than the original uranium that went into the reactor. A person would quite literally drop dead by getting too close.

The storage of this high-level waste is a serious concern for the nuclear power industry, governments, and people in general. One option is to heat the waste to the point that it turns into a dry powder that can be immobilized in Pyrex glass and stored in stainless steel canisters. This process is called vitrification. Another storage option was developed in Australia . "SYNROC" is the incorporation of radioactive wastes "in the crystal lattices of the naturally-stable minerals in a synthetic rock. In other words, copying what happens in nature." But neither of these techniques solves the problem of final disposal.

"Final disposal" is the most controversial issue of all because the only solution receiving serious consideration is "deep geological disposal" the burial of radioactive waste in stable rock structures or bentonite clay that inhibits groundwater movement. This is only a temporary answer to the radioactive problem. No material used to encase the waste can withstand the continuous assault of heat, helium, and hydrogen that the spent fuels produce. The nuclear industry frankly admits that such a "solution" carries the risk of contamination to underground water tables. Eventually the unstable material will reenter the ground and poison the groundwater. Consider this the longest any language has continuously been spoken is 4,000 years. This spent fuel will remain lethal for more than 10,000 years. What language will be used to make the signs warning people of the distant future away from the site?

"Some countries believe that the final disposal of high-level radioactive wastes and/or spent fuel should be delayed as long as possible." But in an effort to get this dangerous material out of sight and out of mind, the nuclear industry has identified possible dumpsites. In 1987, Yucca Mountain , Nevada , was selected as a potential repository for the 77,000 tons of nuclear waste awaiting disposal from the US 's 110 nuclear plants. Thousands of researchers and scientists have been testing the region's rock formations, climate, and groundwater flows.

According to the Nuclear Waste Policy Act, "if, at any time, Yucca Mountain is found unsuitable, studies will be stopped immediately. If that happens, the site will be restored and DOE will seek new direction from Congress." The entire project from start to finish, that is if it goes, is estimated to cost $18.7 billion.

Apparently the 621 earthquakes of a 2.5 rating or greater that have occurred within a 50 mile radius of Yucca Mountain since 1976 have not proven the site "unsuitable." Hundreds of these earthquakes have happened during DOE's site evaluation. According to Nevada 's Nuclear Waste Project Office (NWPO), Yucca Mountain itself is "a result of millions of years of intense faulting and volcanism. Records of recent events indicate that faulting is an ongoing process in the vicinity of Yucca Mountain that is expected to continue long into the future. Thirty-three faults are known to exist within and adjacent to the Yucca Mountain site." The NWPO as well as two-thirds of Nevadans oppose the project altogether.

Despite the lack of a dependable solution for disposing of the radioactive waste, nuclear power plants are still being constructed. Why? Because of statistics such as this: 2 million tons of coal is burned in order to produce the same amount of electricity that 21 tons of spent uranium fuel produces. That is almost 10,000 times more, not to mention the 5.4 million tons of CO 2 ; 120,000 tons of ash; and 50,000 tons of SO 2 that are emitted in the coal-burning process. But people tend to forget that the radioactive materials discarded in the nuclear fuel process cannot be filtered out of the environment in a blink of geologic time.

Nuclear operations are especially harmful to indigenous people who will be affected by a plant but whose refusals go unheeded. Jabiluka (Djabulukku), Australia is home to one of the biggest and highest-grade uranium deposits in the world an estimated 212,400 tons of uranium oxide. It also happens to be in the middle of a national park in a beautiful floodplain that the Mirrar people call home. Although the Mirrar clan leaders "have clearly stated that they are opposed to any mining operations at the site," the Jabiluka Uranium Mine proposal may become a reality. Sometime in 1999, a tunnel will be dug "toward the uranium orebody, without a clear plan for where the ore will be milled or what will happen to 19 million tonnes of powdered radioactive waste rock produced by the mine. What is clear is that mining, far from providing benefits to the local community, is instead destroying them." The Mirrar fear this mine "will push their culture past the point of cultural exhaustion to genocidal decay."

Fortunately, a more permanent solution for dealing with radioactive waste is in the works. Paul Brown of International Fission Fuels, Inc., recommends the transmutation of spent fuels into "short lived or stable products." This could be done with an accelerator-driven reactor that "may be used to 'burn up' spent fuel from fission reactors." It would speed up electrons directed onto a metal such as tungsten in order to create gamma rays capable of disintegrating radioactive materials. This reaction would require about 1 MW of power and produce about 20 MW of power, so the use of multiple reactors would provide "a relatively cheap and safe source of power at the same time." The fuel to generate this power is obviously abundant; all that needs doing is constructing an experimental prototype.

Until such reactors are made a reality, nuclear power will remain a threat to the global community for thousands of generations. Common sense has been lost somewhere along the

line and current regulations in the US only cover the next 1,000 years. Yet we continue to depend on a form of electrical generation that produces many times more radioactive waste and spent fuel than it uses, even though we are not sure how to dispose of the waste products. In fact, the production of nuclear energy would be more aptly called the production of lethal, uncontainable waste whose existence shatters the significance of our present electrical needs.

Evidence #4: Nuclear plants employ the largest workforce annual income based on both large capacity and being a labor-intensive technology.

NEI Nuclear Notes

News and commentary on the commercial nuclear energy industry.

TUESDAY, AUGUST 24, 2010

Comparison of Energy Technologies on Economics, Jobs, Land Footprints and More

Last May, Public Utilities Fortnightly published an independent analysis by Navigant Consulting that provided some great comparisons between various energy technologies. One of the comparisons is the number of jobs created on an equivalent basis.

To analyze the economic and workforce contributions of various energy technologies, the authors began by reviewing the contribution of permanent direct local jobs per megawatt of installed electric capacity for the most common types of generation technologies…

FIG. 1 JOBS PER MW

Comparison of permanent direct local jobs per megawatt of installed electric capacity.

Technology	Jobs/MWe
PV	1.06
Nuclear	0.5038
CSP	0.47
Micro Hydro < 20 MW	0.45
Hydro > 20 MW	0.19
Coal	0.1866
Hydro > 500 MW	0.1137
Hydro Pumped Storage	0.0954
Combined Cycle	0.0544
Wind	0.049

On top of jobs, the analysis calculated the workforce impacts from each technology. Here's what it said about nuclear:

Nuclear plants create the largest workforce annual income based on both large capacity and being a labor-intensive technology (see Figure 3). The average wages in the nuclear industry compare favorably with other power generation technologies. While nuclear

power plant operator wages may approach $50 an hour, the large support staff and security force wages tend to lower the overall average below that of other technologies.

Fig. 3 Workforce Income Impacts

Direct workforce income attributable to a single average-sized plant of given generation technology.

Technology	Jobs/ MWe	Average Size (MWe)	Direct Local Jobs	Average Salary ($/hour)	Workforce Income ($/year)
Nuclear	0.5038	1,000	504	$31	$32,485,024
Coal	0.1866	1,000	187	$28	$10,987,904
Hydro > 500 MW	0.1137	1,375	156	$33	$10,792,791
Hydro Pumped Storage	0.0954	890	85	$38	$6,696,842
Hydro > 20 MW	0.19	450	86	$33	$5,790,470
CSP	0.47	100	47	$27	$2,618,990
Combined Cycle	0.0544	630	34	$28	$2,018,100
PV	1.06	10	11	$15	$334,468
Micro Hydro < 20 MW	0.45	10	5	$35	$326,196
Wind	0.049	75	4	$35	$291,200

The article goes on to provide a few other equivalent comparisons such as land footprints and construction lead times. Make sure to check out the rest of the four page piece, it's quite good.

Posted by David Bradish at 7:55 AM ShareThis

9 comments:

Philip said...

Curious article. No mention of the massive infrastructure of mining and transportation required for Coal. It seemed to be only the impact on the local workforce from the generating plants themselves. A very myopic view IMO.

August 24, 2010 1:20 PM

gmax137 said...

So, being 'labor-intensive' is a good thing?? I don't think so. Else we could generate power with a million human powered treadmills... The advantages of nuclear power all proceed from the six orders of magnitude greater energy density (compared to chemical derived power). Touting lots of jobs is just pandering.

August 24, 2010 3:28 PM