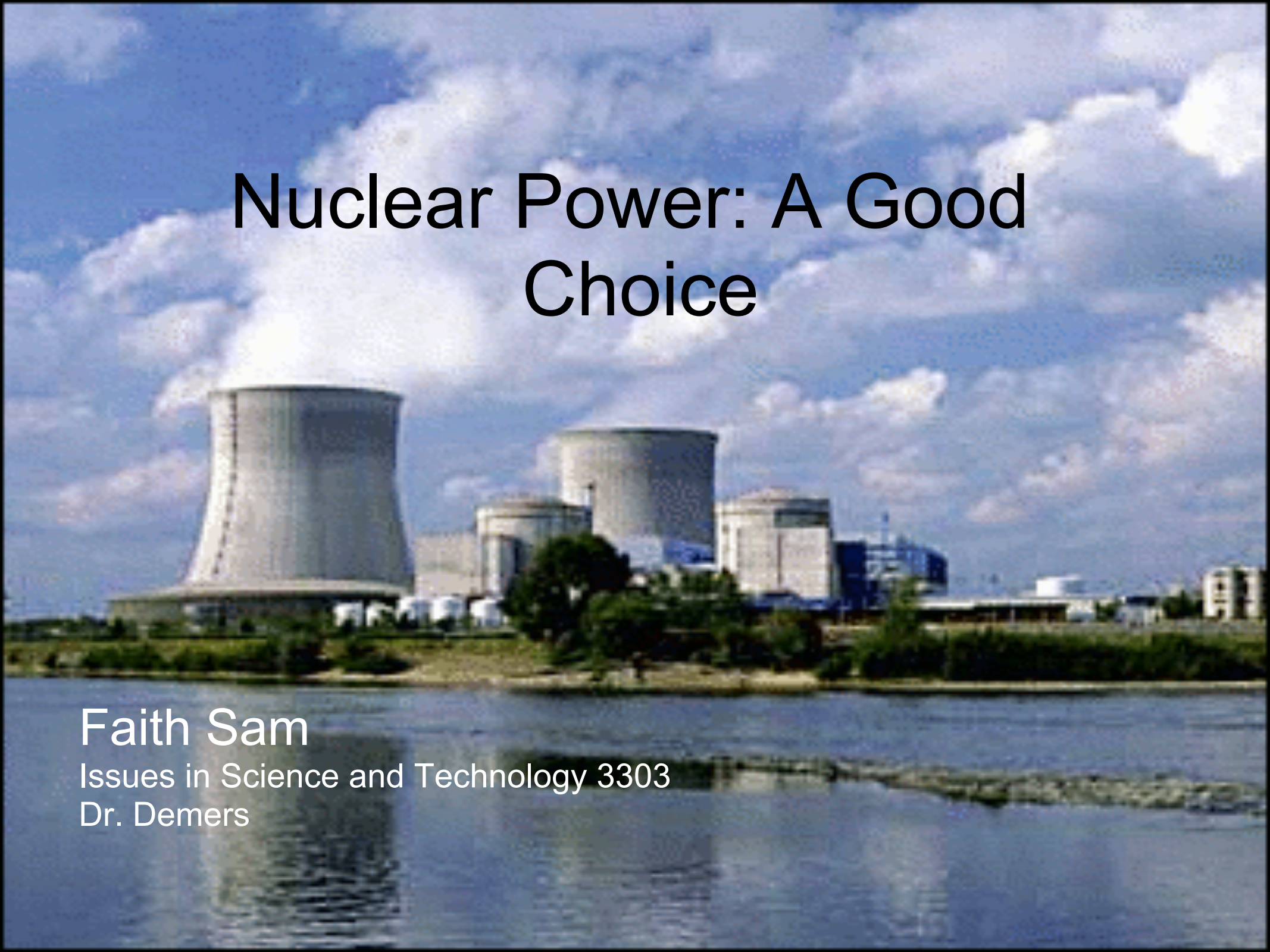


Nuclear Power: A Good Choice

Faith Sam
Issues in Science and Technology 3303
Dr. Demers

Outline

- History
- France as a good example

- How nuclear power is created
- Negative sides
- Why nuclear power is a good source of energy

- Religious aspects
- Moral aspects
- Political aspects
- Cultural aspects
- Economic aspects

- Future: where it is heading

Brief History

- 500,000 BC. Man-made fire
- 700-600 BC. The first water wheel used for power was in Egypt.
- 500-900 AD. Windmills were developed to automate grinding grain and pumping water.
- 1789. The first complete analysis of pitchblende by Martin Klaproth. Uranus = ‘uran’ = Uranium
- 1901. Discovery that polonium and radium in pitchblende were directly linked to uranium.

History Continuted

1938. The atom was split into two parts.

1945. The first nuclear bomb was tested in the desert range, Alamogordo. Used to bomb Japan.

1954. The first nuclear power plant was built.

2007. Possibility of 21 new nuclear power plant applications in the United States.

2011. The first floating nuclear power plant is expected to come into service in Russia.

France: A Good Example

It is "the world's largest net exporter of electricity due to its very low cost of generation" (Nuclear in France, 2009).

58 nuclear power reactors spread across France.

Large level of energy independence

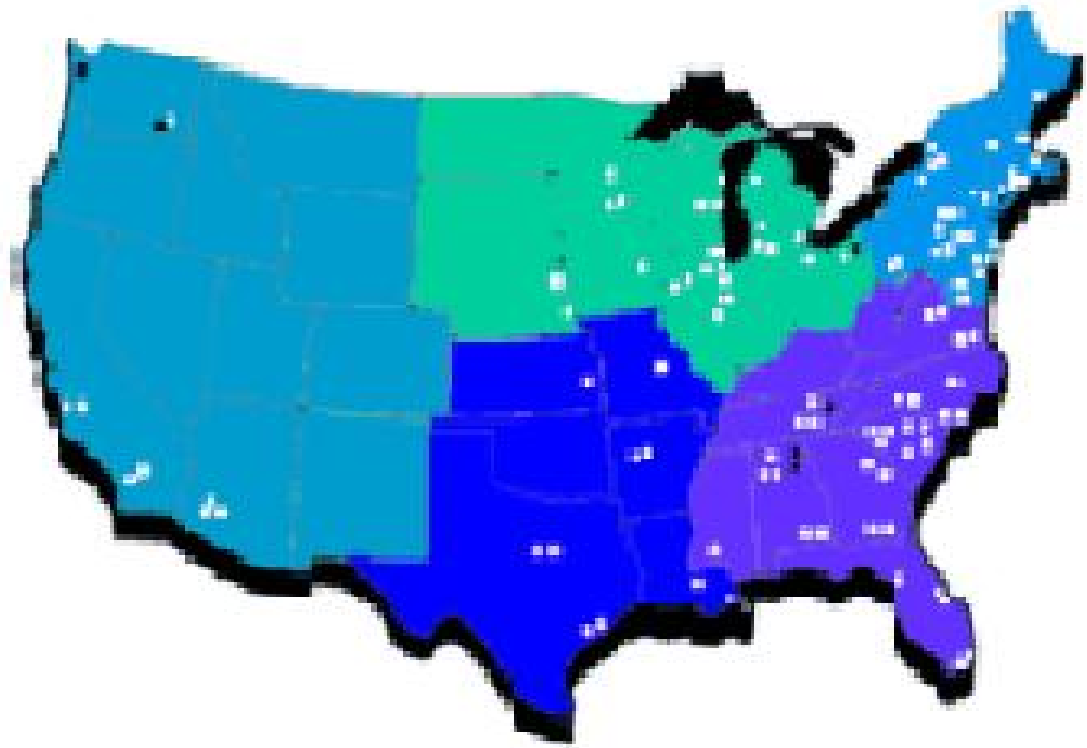
Extremely low level of CO2

Second lowest cost in electricity in Europe.

Nuclear power reactors in France

Other Contries

- Russia
- Spain
- 121 disposal sites around the United States.
- (Map) Commercial nuclear power plants
- Five nuclear power plants in Florida

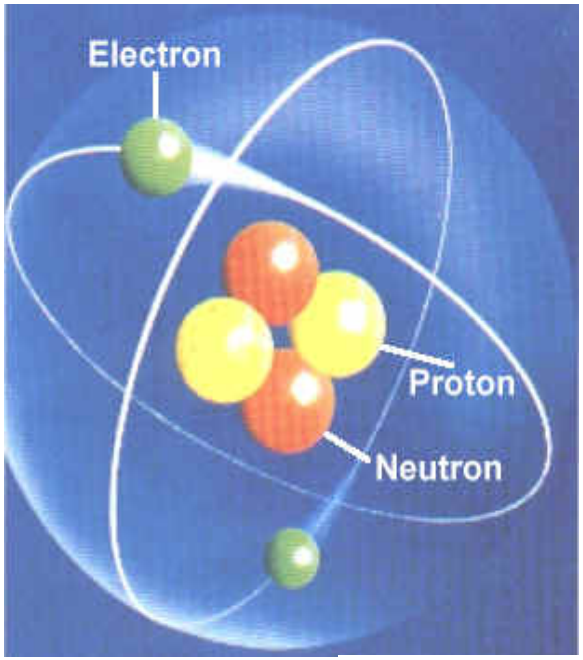


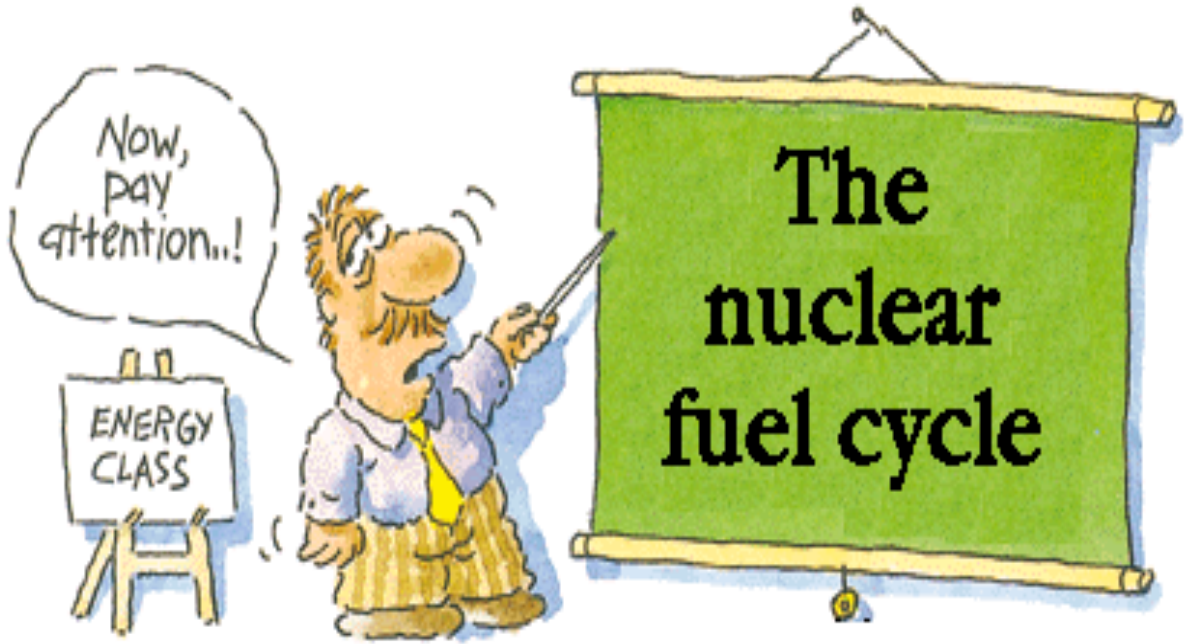
Florida

UNIT	LOCATION
Crystal River 3	Crystal River
Turkey Point 3	Turkey Point
Turkey Point 4	Turkey Point
St. Lucie 1	St. Lucie County
St. Lucie 2	St. Lucie County

(Nuclear Reaction, 2008)

How is nuclear power created???

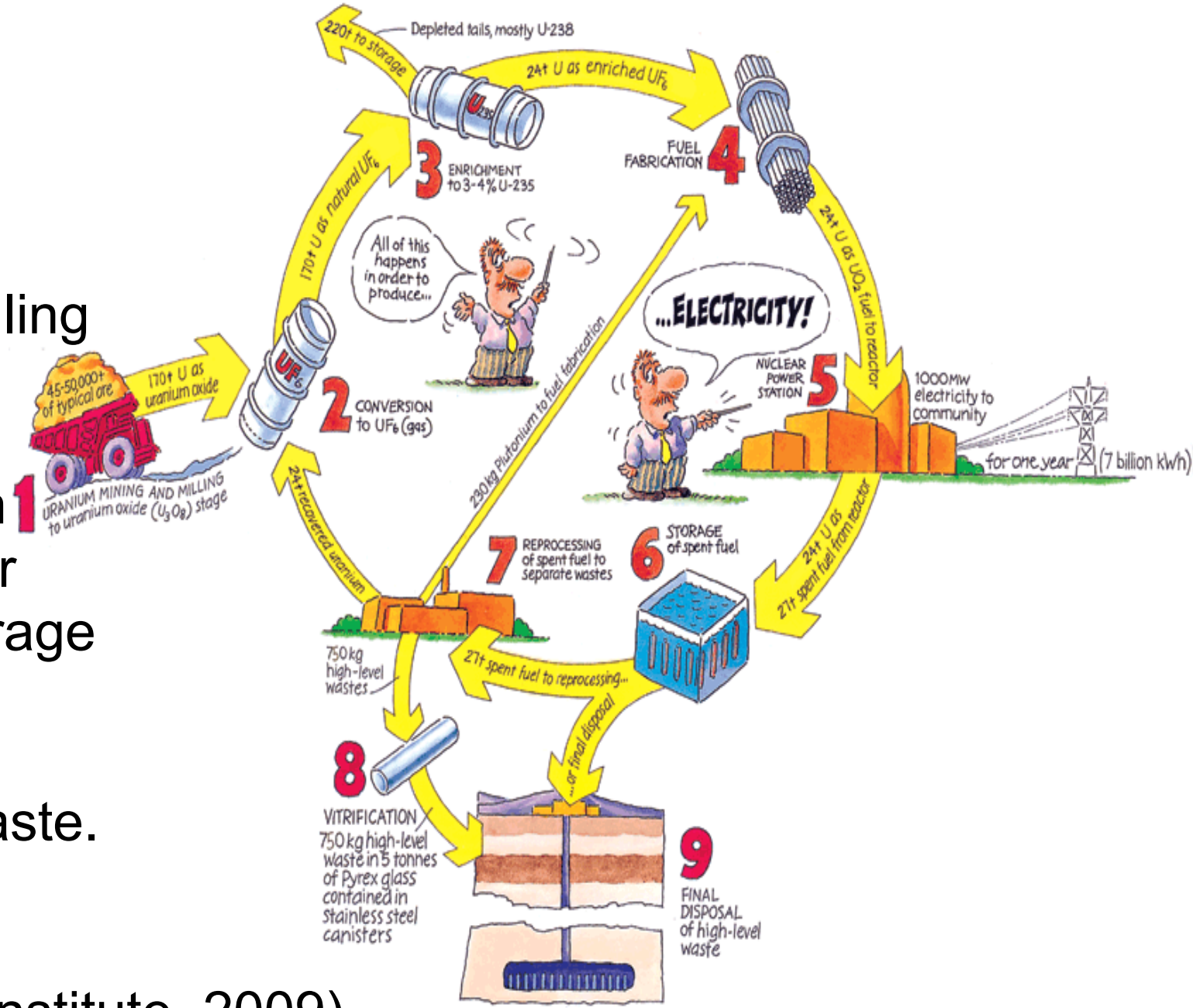




Nuclear Fuel Cycle

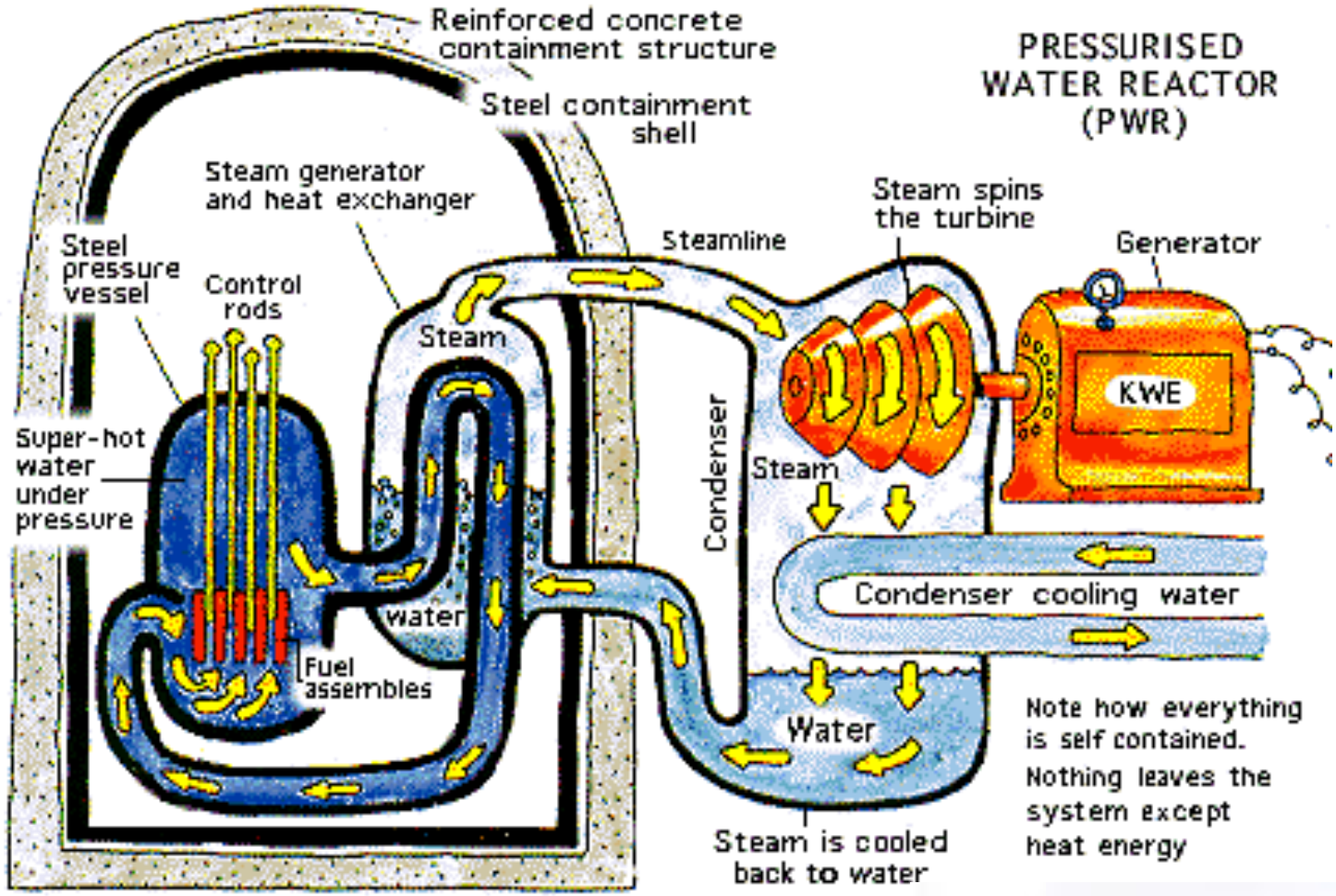
Nine steps:

1) mining and milling
2) conversion
3) enrichment
4) fuel fabrication
5) nuclear reactor
6) temporary storage
7) reprocessing
8) recycling
9) disposal as waste.

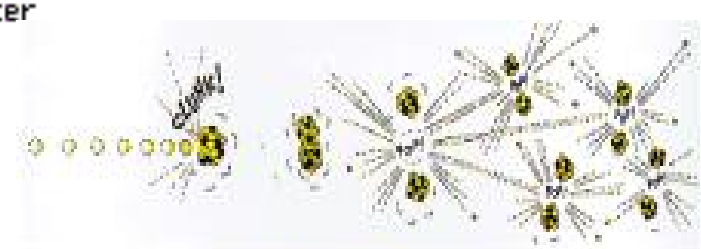


(Nuclear Power Institute, 2009)

The control rods absorb neutrons. They can be inserted or withdrawn to set the reactor at the required power level.



Pressurized Water Reactor. (What is uranium? 2006.)



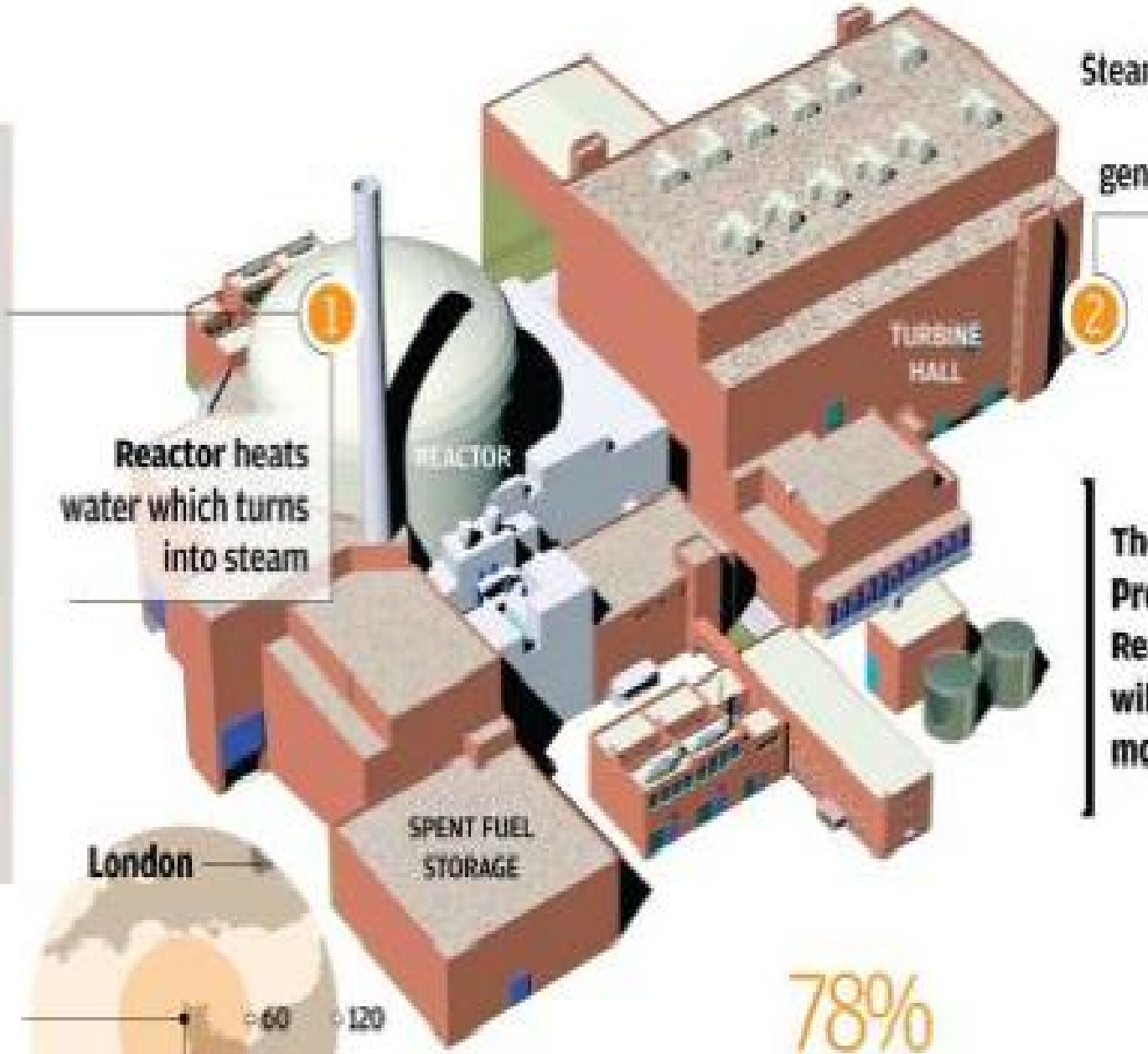
(What is uranium? 2006.)

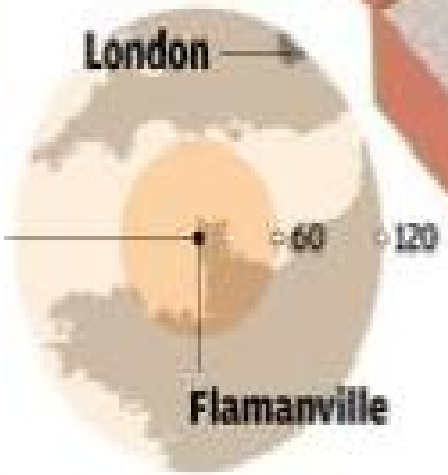
» Main reactor

Reactor heats water which turns into steam

Steam forced through turbine which generates electricity

The European Pressurized Reactor (EPR), will be France's most powerful





78%
Proportion of French energy provided by nuclear power

59
Number of nuclear reactors in France

GRAPHIC: Michael Agar | Archie Bland

SOURCE: Areva | Large Associates | Energy Information Administration

Concerns about nuclear power

- Long construction periods
- Long licensing process
- High cost
- Radioactive substance
- Affects on the body if nuclear power is released
- Transportation
- Non-degradable metals polluting the earth
- Development of expertise in nuclear materials.

Three Mile Island

- 1979
- People got scared
- No deaths or injuries

Radiation Per Person

Three Mile Island	Chest x-ray
Avg. 1 millirem	Avg. 6 millirem

(Fact Sheet on the Three Mile Island Accident, 2009)

Chernobyl

The worst nuclear power plant accident in history

- Two workers present on the site died
- Twenty-eight workers died over the next four months from radiation sickness
- Released at least five percent of the radioactive reactor core into the atmosphere and downwind.
- “ The downwind “
- Thyroid cancer developed in 4,000 children
- Out of the 4,000 children, 99% of them were successfully treated.

Why nuclear power is a good choice

Six concerns that will be addressed are

1) amount of waste created

2) is nuclear power environmentally friendly?

3) radioactive substance

4) bombs made out of nuclear waste

5) safety
   -including safety regulations
   -safety in transportation

6) cost.

Concerns

1) Amount of waste created = Very small amount

4 people's nuclear waste =

2) is nucl

The following table shows the differences in CO2 output from various electric power fuel sources[2].

Fuel	**Output Rate** (pounds CO2 per kWh)
Coal	2.11
Petroleum	1.92
Natural Gas	1.31
Other Fuels	1.38

Table 1 CO2 Output Rates for Power Generation Fuels

[2] Carbon Dioxide Emissions from the Generation of Electric Power in the United States, July 2000, Department of Energy, Washington, DC 20585, Environmental Protection Agency, Washington DC 20460

Nuclear power falls in the category of “other fuels”

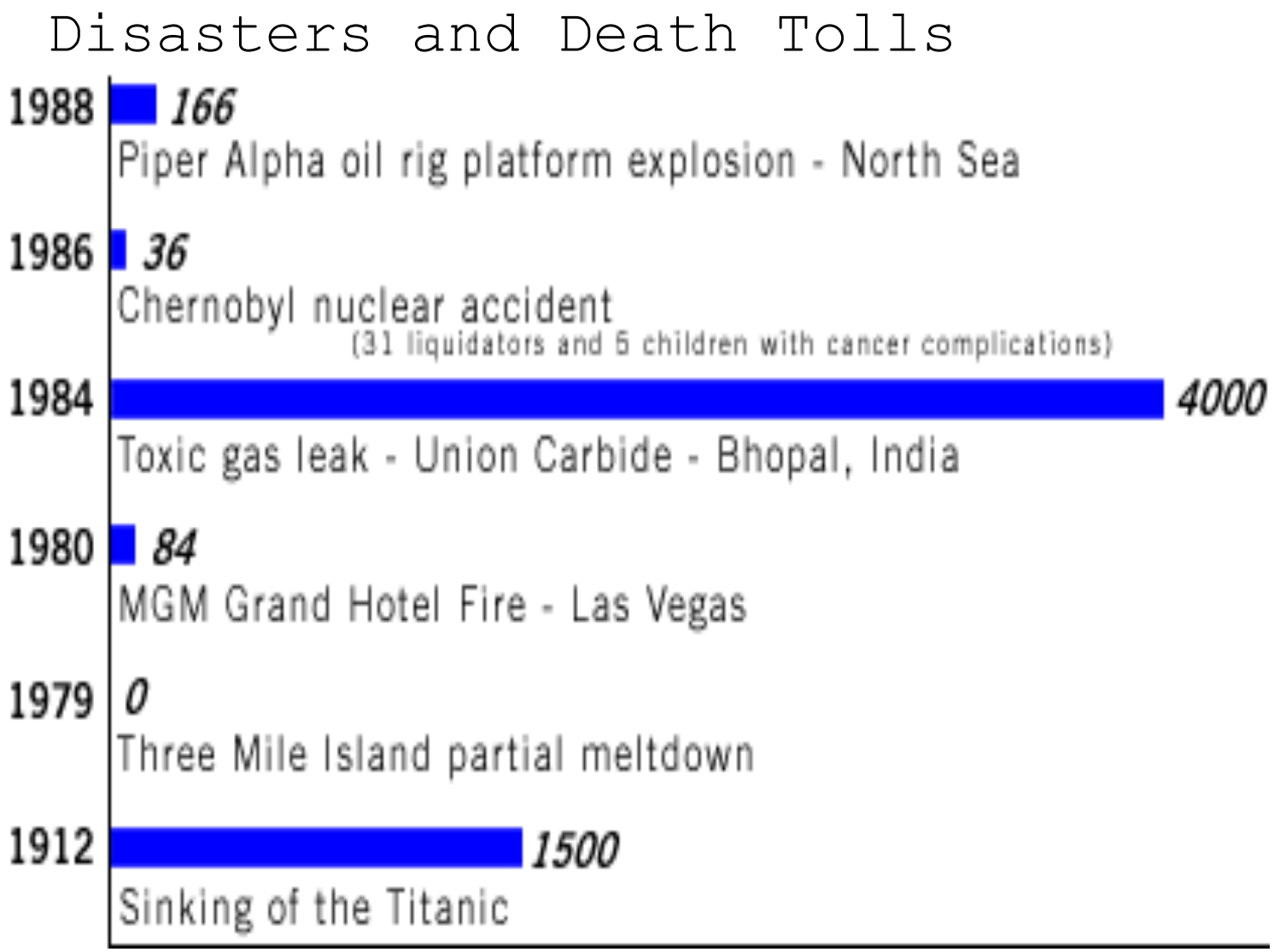
Concerns Continued...

3) Radioactive substance
"You could not legally bring coal power plant fly ash or any derivative materials into a nuclear power plant because it would exceed legal limits and set off detectors." (Krieg and Gabbard, 2005)

"The fly ash emitted by a power plant… carries into the surrounding environment **100 times more radiation than a nuclear power plant producing the same amount of energy**"

- Radioactivity causing sickness or cancer.

Apart from the increase in thyroid cancer, no increase in overall cancer or non-cancer diseases have been observed that can be attributed to the Chernobyl accident and exposure to radiation (Backgrounder on Chernobyl Nuclear Power Plant Accident, 2007).



(PBS Nuclear Reactor, 2008)

Concerns Continued...

4) Could bombs be made out of nuclear waste?
   - It would be extremely difficult; almost impossible.

5) Safety

   Nuclear power plant
   - Can not explode
   - Fire can not happen
   - No way that a nuclear power plant can blow up like a weapon

   (Backgrounder on Chernobyl Nuclear Power Plant Accident, 2007).

   "The risk to the most exposed member of the public from living adjacent to a nuclear generating station is equivalent to smoking less than one cigarette per year…of being in a smoke-filled room for 15 minutes, or of eating ten peanut-butter sandwiches " (Robertson, 1984).

5) Safety Continued...

Fatality Comparison Statistics		
US Coal Mining	1931-1995	33,134
Oil / Gas Industry	1992-1995	719
Chemical Manufacturing	1992-1995	201
US Automible	1899-1995	2,903,036
Smoking	per year	419,000
US Civil Aviation	1938-present	+54,000
US Nuclear Power	Historical	0

(PBS Nuclear Reaction, 2008)

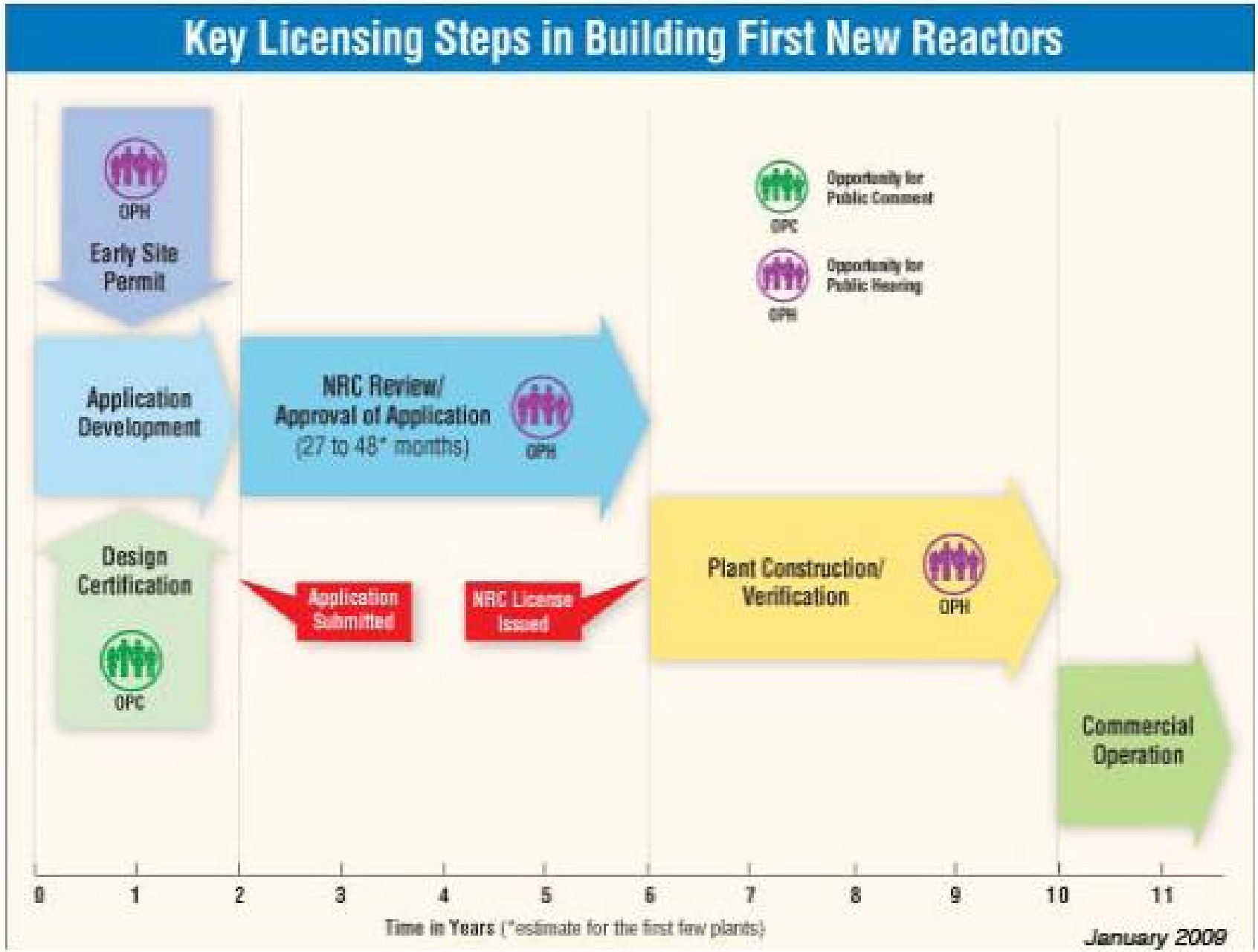
Important note: These are comparisons in the United States, therefore the results for nuclear power do not include Chernobyl which did have fatalities.

- Many of our other energy sources and ways of life are more fatal

5) Safety Continuted...

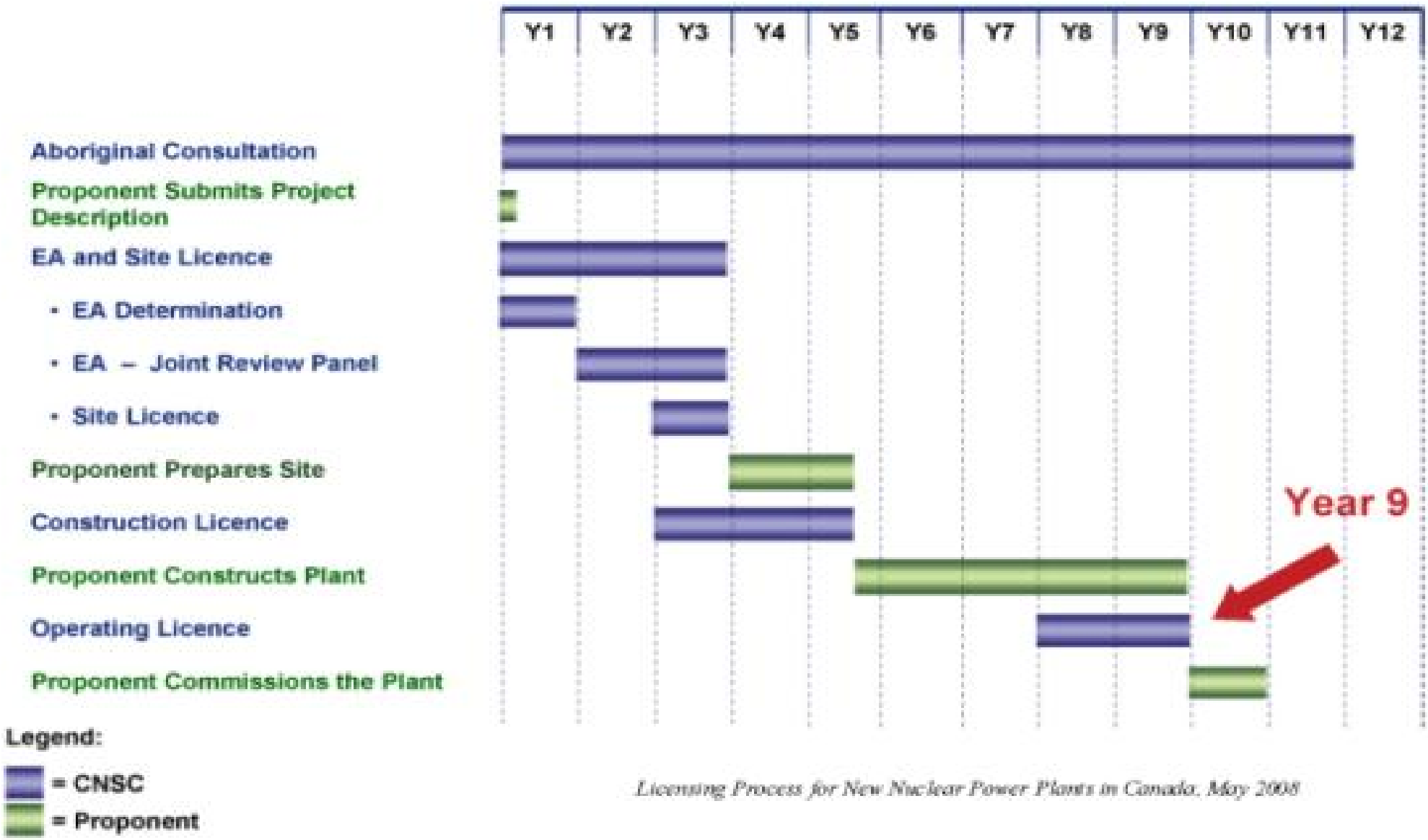
Safety Regulations

- Early Site Permit; including a hearing.
- Application Development: developing and submitting an application must include safety and environmental information.
- opportunity for the public people to discuss the nuclear reactor's design safety.
- NRC Review/Approval of Application takes approximately three years: public hearing for construction and operating license (COL).
- Plant Construction/Verification; tests
- Another hearing: if there is the possibility that the criteria defined in the license has not been met.
- Commercial Operation: the power plant is not put into full operation until the system and equipment has been tested.



(Nuclear Energy Institute, 2009).

Environmental Assessment (EA) & Licensing Process for New Nuclear Power Plant



Licensing Process for New Nuclear Power Plants in Canada **P. 18)**

5) Safety Continued...

Safety in transportation

- Extremely robust canisters
- The waste has approximately four tons of the protective shielding.
- "Tests have proven that containers can withstand high-speed crashes, extremely hot and long-lasting fires, and submersion in water" (NEI, 2009).

Transportation casks must pass rigorous safety tests before being certified.

(Yucca Mountain Repository, 2008)

- For 40 years, our country has shipped more than 3,000 shipments of nuclear fuel without any damage, injuries or environmental damage (NEI, 2009).

6) Cost

Fuel	Uranium	Coal	OPEC Oil	Natural Gas
Cost / million BTU equivalent[7]	$0.01	$1.25	$5.70	$3-4
Wasted fuel	American lack of reprocessing wastes $20 Trillion	Losses due to old plant design	Spills, 'gas guzzling vehicles',	Flaring
Frequency to refuel	1/3 of core is replaced every 18-24 months	Continuously	Continuously	Continuously

(Cost Comparison of fuels, Michel)

- Cost of uranium is less expensive than any of the other fuels
- Only one that is not required to be continuously refueled.

Religious and Moral Aspects

A concern among religions is that even though nuclear power can be used for good, nuclear technology in general, can be used for destruction.

- Mennonite church = nuclear power can be used for good purposes but they are against it being used in any harmful way.
- Christians churches beliefs are divers according to individual religions.
  - Christian church: does not support nuclear power
  - Catholic church: beliefs vary within the church
  - Methodist Church: supports nuclear power
- Buddhists: against possessing, manufacturing and using nuclear weapons but no mention is made about being against nuclear power

Political Aspects

- Iran developing nuclear weapons.
- Waste disposal and Nevada's Yucca Mountain
- In 2009 the Obama administration opposed the opening of Yucca Mountain.
- Obama administration is devising a new strategy for depositing of nuclear waist (Reuters, 2009 and Yucca Mountain Repository, 2008).

Cultural Aspects

Nuclear power plants

- Open up jobs

-Each nuclear power plant employs “1,400 to 1,800 people during construction and employs 400 to 700 people long-term, at salaries typically substantially higher than the average salaries in the local area” (Nuclear Energy Institute, 2009)

Economic Aspects

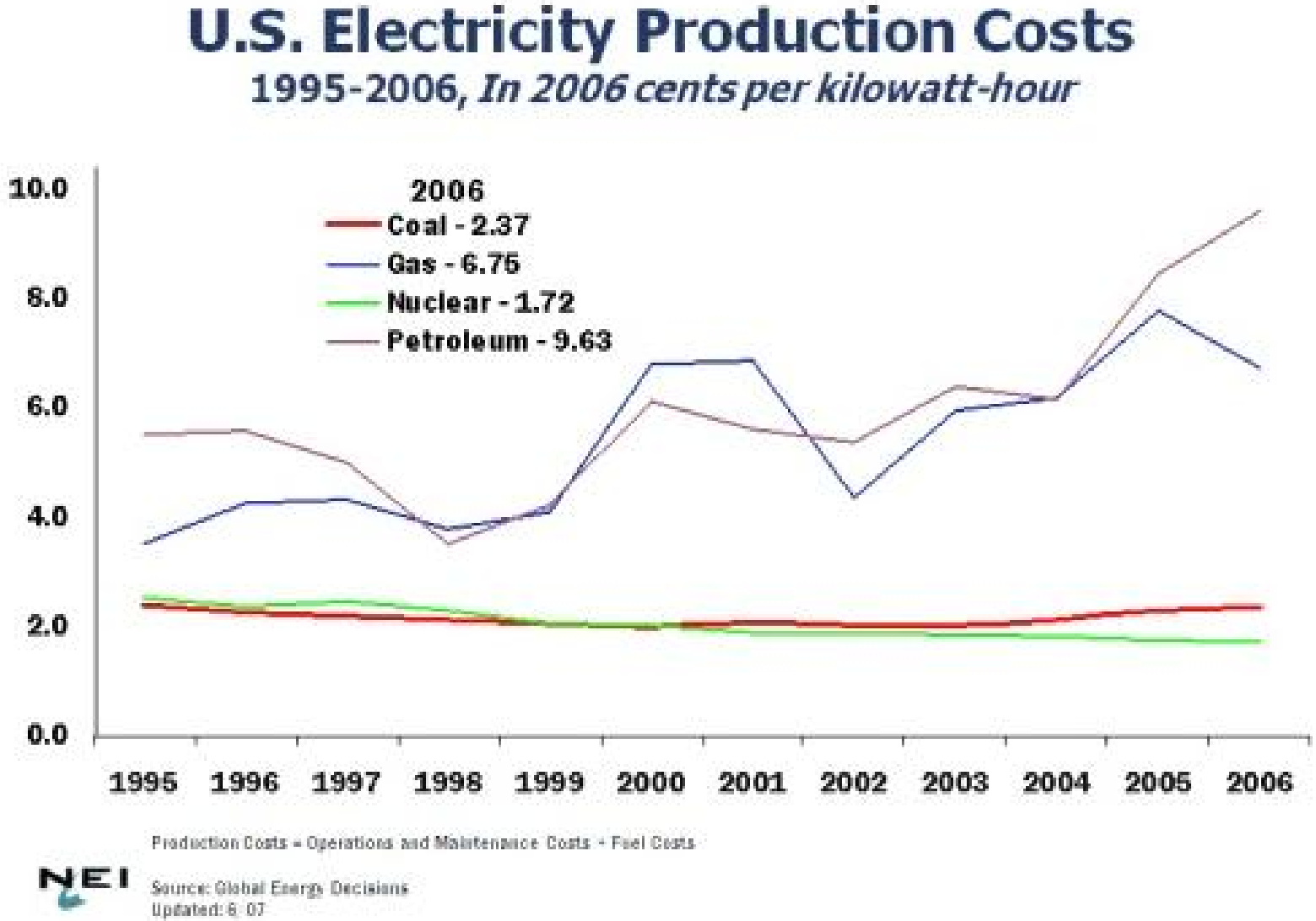
- The cost of building nuclear power plants is higher than that of coal or gas fired. US$7 billion per plant (Nature.com)

- Cost is very low once the plant is built" (Till, 2008).

"The total fuel costs of a nuclear power plant… are typically about a third of those for a coal-fired plant and between a quarter and a fifth of those for a gas combined-cycle plant" (Nuclear Energy Institute, 2009).

- France gains over EUR (Euro) **3 billion per year** from using nuclear power (Nuclear in France, 2009).

- Florida Power & Light Company = planning to build two new nuclear plants at its Turkey Point facility near Miami. Cost for the two is $24 billion total (Greg, 2009).



The cost to generate nuclear power has been declining. While the generation price for coal and gas are generally going up.

Future

- Floating nuclear power plants (FNPPs): Russia plans to have 11.
- Most countries intend to introduce a final disposal site around 2010.
- China is working towards quadrupling its nuclear capacity by 2020
- Russia plans to expand their nuclear market to the point that they will be “a leading international provider of nuclear energy, fuel and technology (Standring, 2009).”

What can we do for the future?

- People can spread the news by word of mouth of where nuclear power is heading and the benefits.

The End

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Any Questions???