

# Chemical Element and Fuel Cell Curriculum

for Upper  
Elementary  
Grades

(4<sup>th</sup> – 6<sup>th</sup>)



# Questions? Contact me:



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### **Acknowledgements:**

My children Margaret and Matthew have been my inspiration for this project. I would like to thank them for their involvement, patience and understanding. Also, thanks to all the hard work and dedication of educators, government, and the energy industry.



## Pre-Activity Discussion:

# What is Energy? What is Electricity?

**Key Concept:** This Pre-Activity lesson will define what energy and electricity is and where the United States of America gets its energy from. It is essential to understand that the United States of tomorrow will be shaped by what we do in classrooms today. Teaching our students about clean air, the environment, alternate forms of renewable sustainable forms of energy will stimulate students to ask intelligent and probing questions about their future.

### Activity:

Video: “State of the Union 2003, January 28, 2003, Energy, President George W. Bush.”

### Important words:



Conserve



Energy



Electricity



Electrons

**State of the Union Address, January 28, 2003, Energy, President George W. Bush**



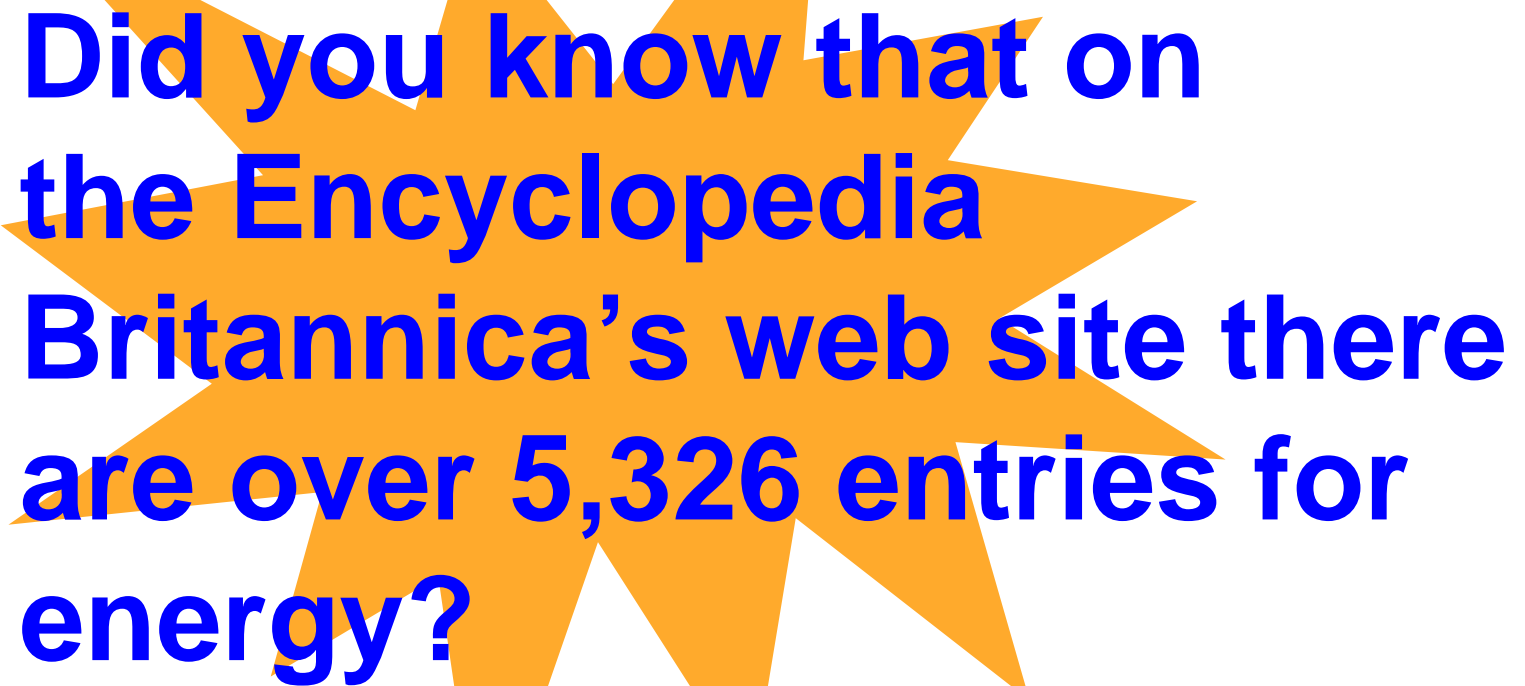
**Double click on Slide and press "Play" to start video.**



**Open discussion  
about video**



# What is Energy?



**Did you know that on  
the Encyclopedia  
Britannica's web site there  
are over 5,326 entries for  
energy?**

<http://www.britannica.com/search?query=energy&submit=Find&source=MWTEXT>

**Let's define energy to mean...**

**Energy: *Noun.***

- 1. The ability to do work.**
- 2. Usable power (as heat or electricity); *also*, the resources for producing such power.**





# What is Electricity?



**The Merriam Webster  
Word Central Student  
Dictionary's website has  
one definition for  
electricity.**


**It defines electricity to mean...**

## **Electricity: *Noun.***

- 1. A form of energy that is found in nature but that can be artificially produced by rubbing together two unlike things (as glass and silk), by the action of chemicals, or by means of a generator**
- 2. Electric current**
- 3. Great excitement <felt the *electricity* in the theater>**



**What do we need  
energy for?**



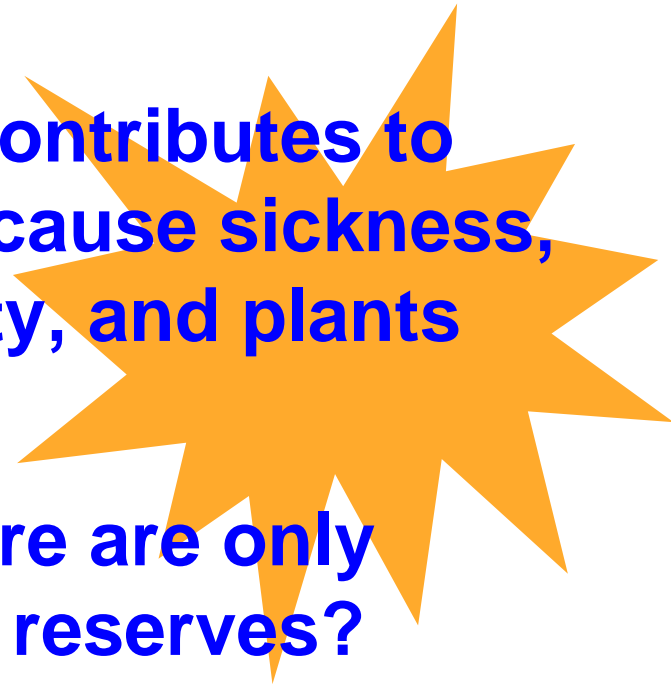
**Are you careful (*do you  
conserve*) or wasteful when  
you use energy?**



**Do you know . . .**

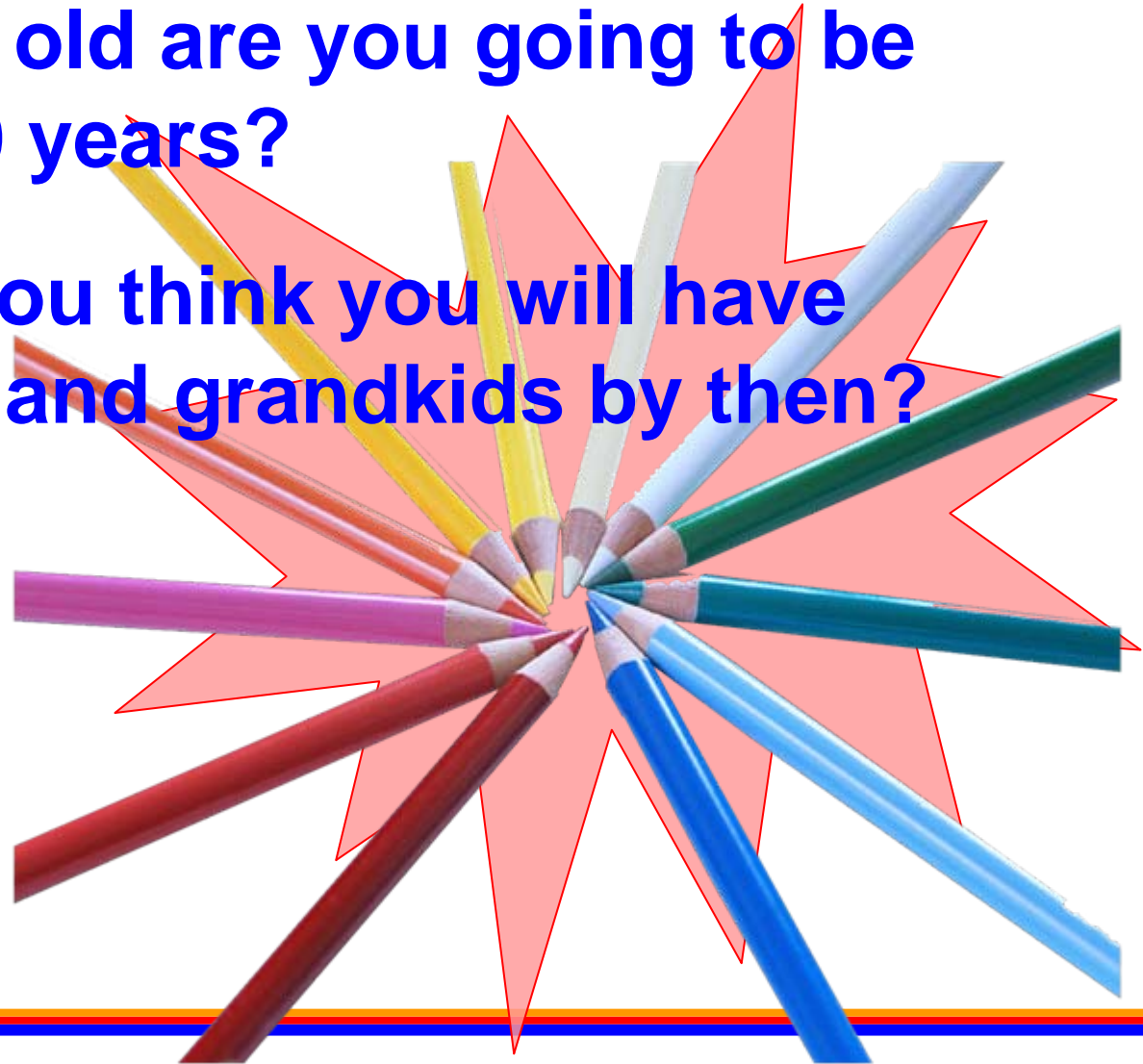
- 
- **What's happening to the cost of gas?**
  - **That gas comes from oil (*fossil fuel*)?**
  - **That making and using gas causes pollution?**

## **Did you know that:**

- **The use of fossil fuels contributes to greenhouse gases that cause sickness, pollution, poor air quality, and plants producing less fruit?**
  - **Some scientists say there are only 70 years left in good oil reserves?**
- 



- **How old are you going to be in 70 years?**
- **Do you think you will have kids and grandkids by then?**



**Do you think they are going to want to live with enough energy and no pollution?**



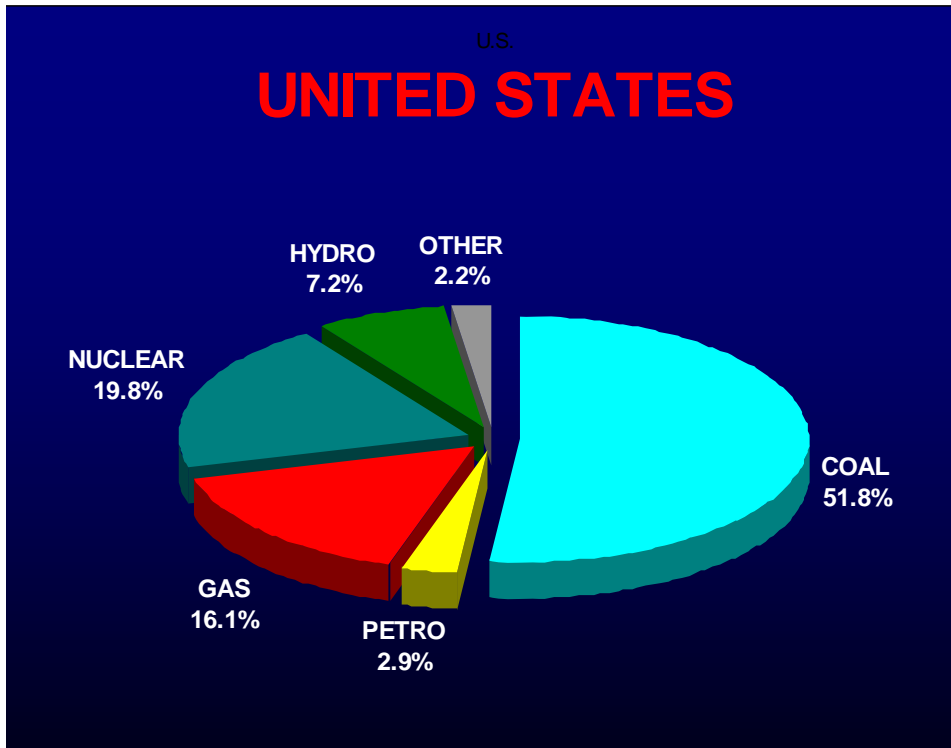


**What does this all  
mean to me?**

**The great news is that you are living in an exciting time with lots of opportunities to help make the world a better place.**

***Lets learn more about how energy is made (generated) in some states.***





Energy costs are different in every state. We get energy from different sources -- coal, petroleum, gas, nuclear, hydro, solar, wind, and others. More than half of our energy is made from coal. Producing energy from coal is one of the least expensive ways but also causes pollution and hurts the environment.

Thanks to modern pollution-control technologies we can lower our costs to make energy and work on having a cleaner, healthier environment.

Source: All of the following charts and graphs are based on information from the Energy Information Administration as presented on the following web site: <http://www.balancedenergy.org/abec/index.cfm?cid=7516>.

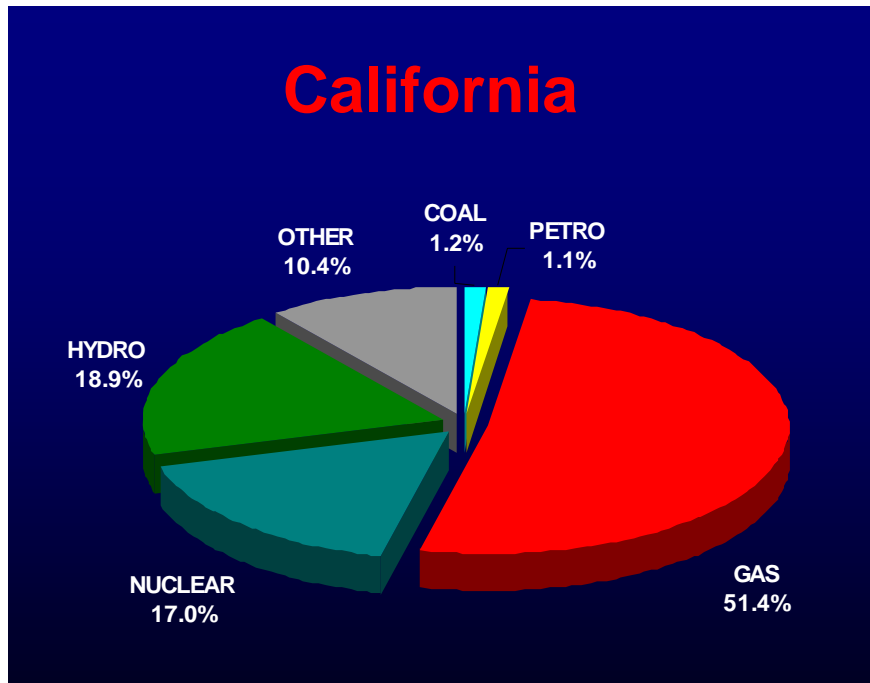
*Please check the website for updates.*

California has the 10th highest retail electricity prices in the nation.

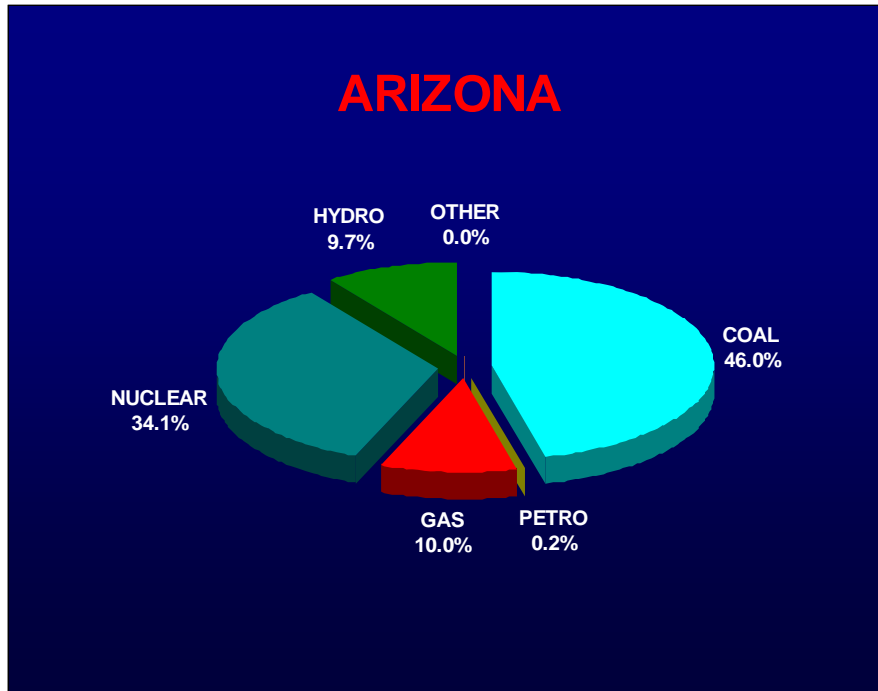
The 2000 state average rate of \$85.30/MWh was 28 percent above the national average retail rate.

The state gets most of its electric energy from gas. Producing electricity from gas causes pollution . . . California has strict standards to protect the environment and is working on improving and expanding the way it gets energy.

The state purchases power for roughly half of its power needs from power plants in Arizona, Nevada, Utah, and Wyoming.



Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516,7760>

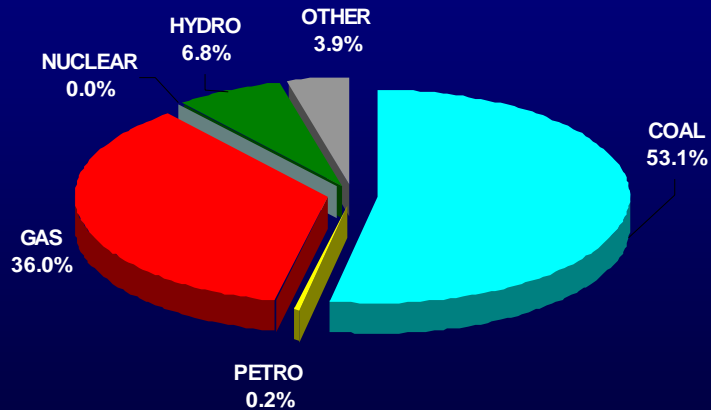


Arizona has the 12th highest retail electricity prices in the country.

Its high power rates (\$71.80/megawatt-hour (MWh)) are attributable to its high nuclear investment (\$3.9 billion), and large stranded investments in cancelled capacity and high distribution costs.

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516,7758>

## NEVADA



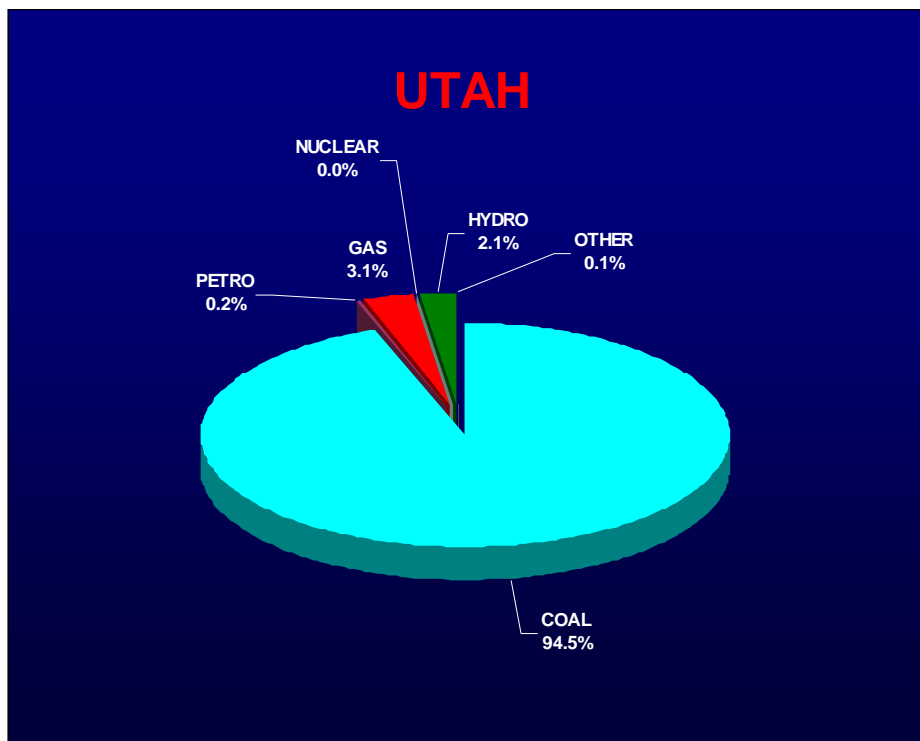
Nevada has the 24th lowest retail electricity prices in the nation.

The 2000 state average rate of \$61.20/MWh was 9 percent below the national average retail rate.

Nevada power rates are low because of their low cost coal (53 percent) and hydroelectric generation (7 percent). The state utilities have made no nuclear investments.

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516,7758>



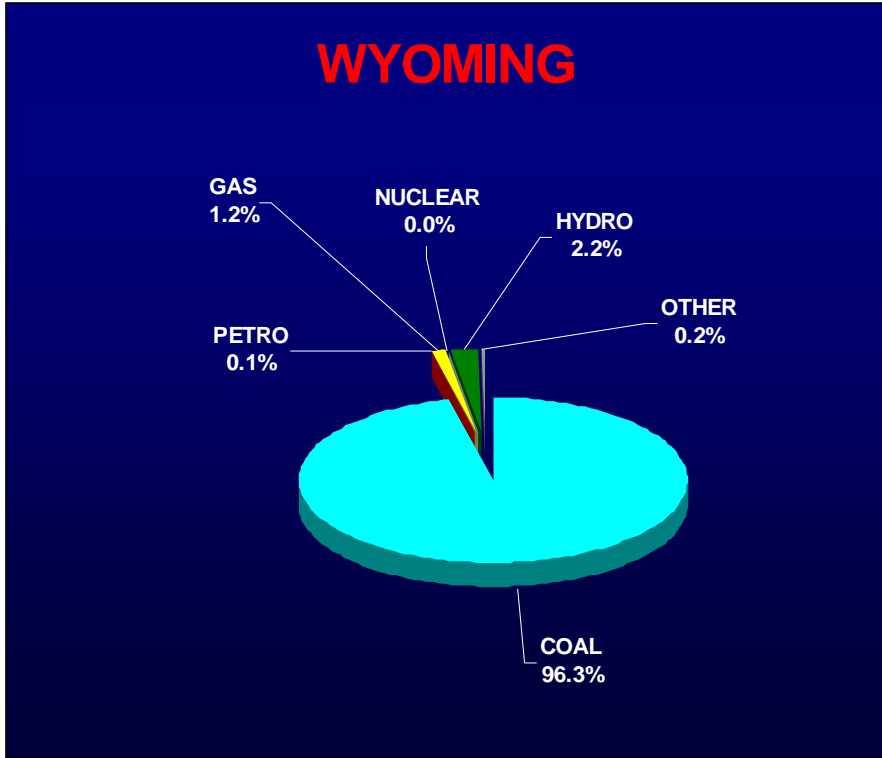


Utah has the 6th lowest retail electricity prices in the nation.

The 2000 state average rate of \$48.20/MWh was 28 percent below the national average retail rate.

Utah power rates reflect the use of low-cost coal. Most coal is from local mines.

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516%2C7801>



**Wyoming has the 3rd lowest retail electricity prices in the nation.**

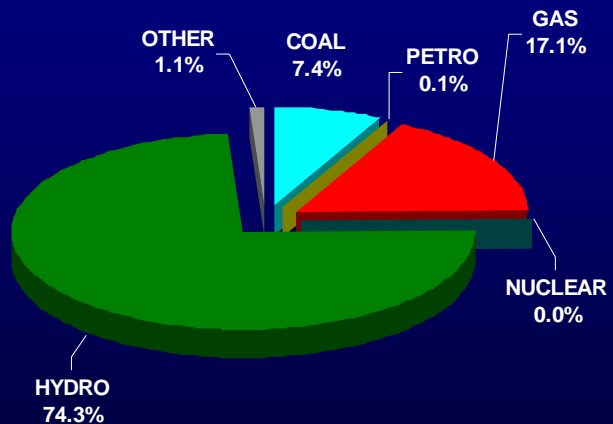
**The 2000 state average rate of \$43.80/MWh was 35 percent below the national average retail rate.**

**Wyoming power rates reflect the use of low cost local coal (97 percent).**

**Wyoming utilities are a short distance from the Wyoming coal mines, providing Wyoming a significant coal price advantage over most Western states.**

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516,7807>

## OREGON



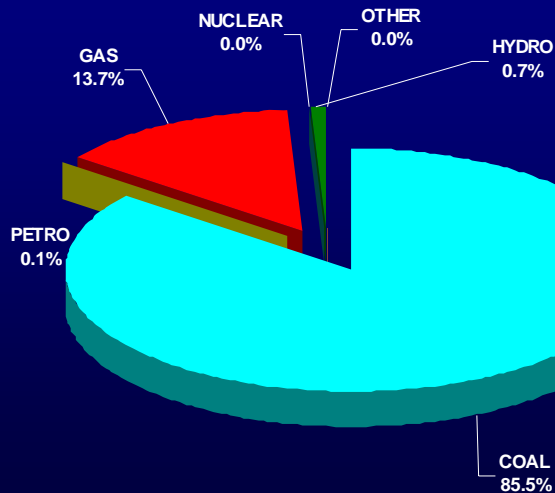
Oregon has the 5th lowest retail electricity prices in the nation.

The 2000 state average rate of \$47.80/MWh was 29 percent below the national average retail rate.

Oregon power rates are extremely low because of their high use of low-cost hydroelectric power (74.3 percent).

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516%2C7795>

## NEW MEXICO

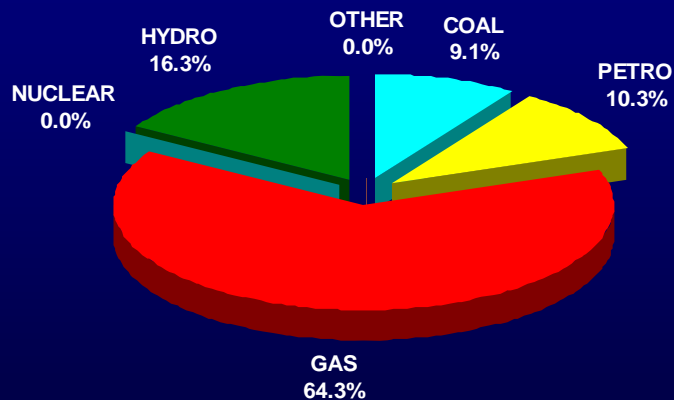


New Mexico has the 19th highest retail electricity prices in the nation.

The 2000 state average rate of \$65.80/MWh was 2 percent above the national average retail rate.

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516%2C7786>

## Alaska

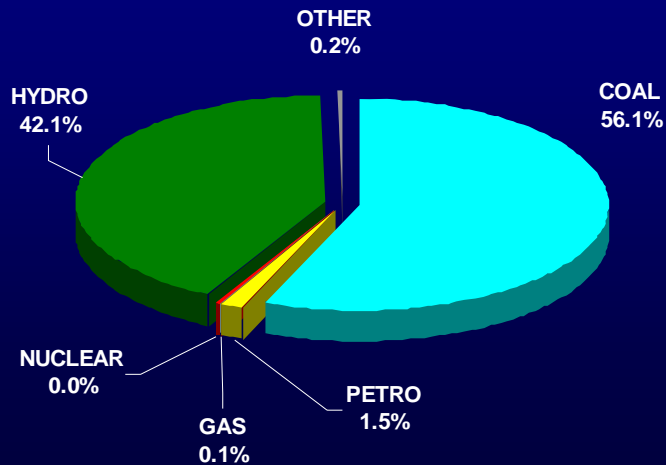


Alaska has the 5th highest retail electricity prices in the country (50 percent above the national average).

The state's very high power prices (\$99.80/MWh) are attributable to high production costs from small-dispersed gas-fired generation.

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516%2C7756>

## MONTANA



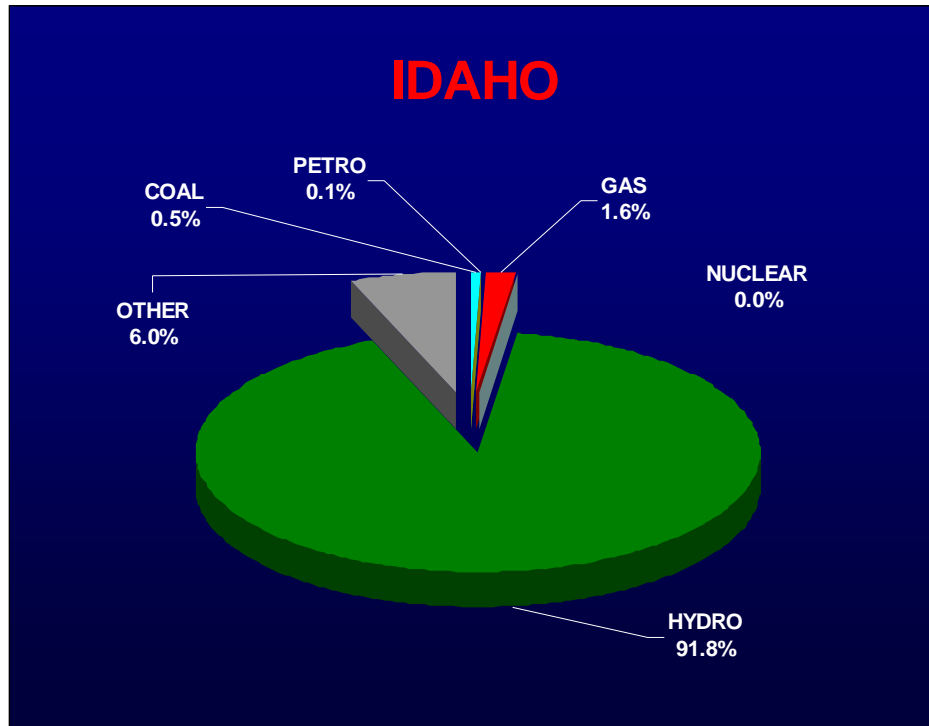
Montana has the 7th lowest retail electricity prices in the nation.

The 2000 state average rate of \$50.30/MWh was 25 percent below the national average retail rate.

Montana power rates are very low because of a high proportion of low-cost coal (56 percent) and hydroelectric generation (42 percent).

Its low cost structure has made Montana a large net power exporter.

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516%2C7779>



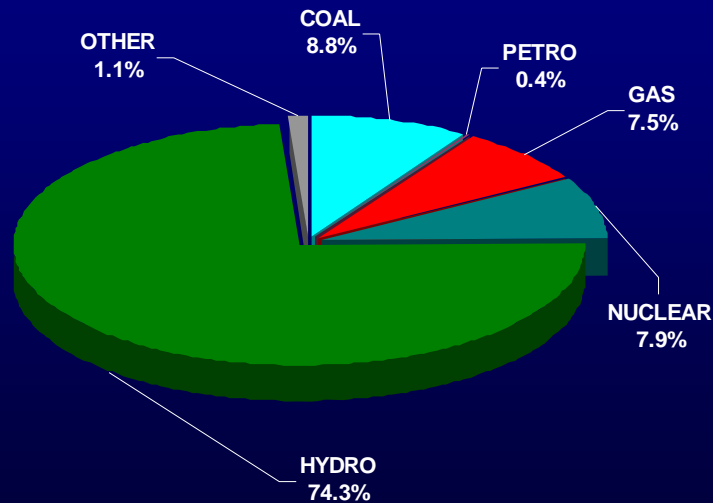
Idaho has the 2nd lowest electricity prices in the nation, ranking behind only Washington.

The 2000 state average rate of \$41.90/MWh is 37 percent below the national average retail rate.

Idaho's very low rates reflect the low generating costs of its hydroelectric and two out-of-state coal units.

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516%2C7766>

## WASHINGTON



Washington has the 4th lowest retail electricity prices in the nation.

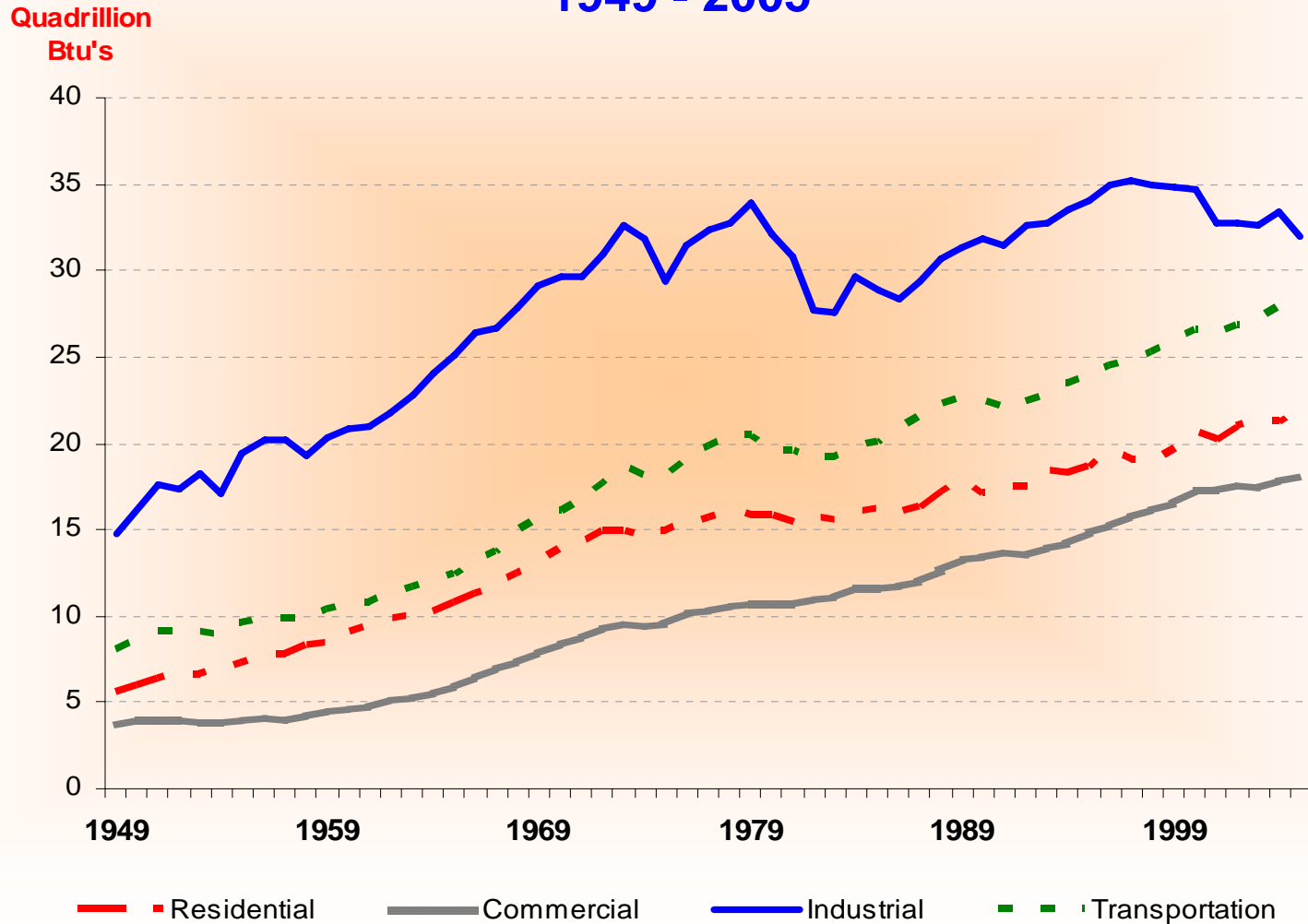
The 2000 state average rate of \$44.80/MWh was 33 percent below the national average retail rate.

Washington power rates are extremely low because of the state's high use of low-cost hydroelectric power (74 percent).

Source: <http://www.balancedenergy.org/abec/index.cfm?cid=7516%2C7804>

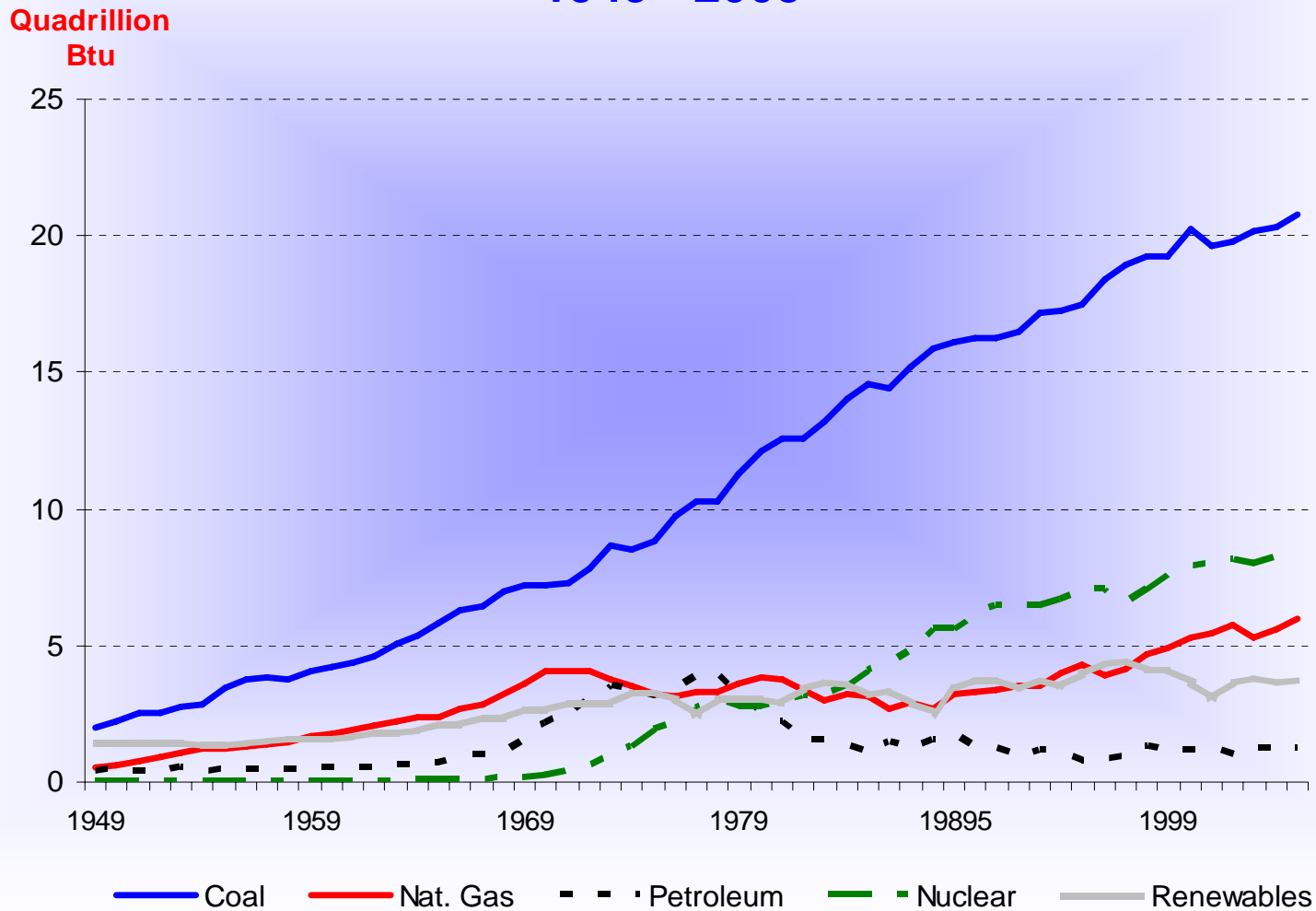


# Total Energy Consumption by End-Use Sector 1949 - 2005



Source: <http://www.eia.doe.gov>

# Total Energy Consumption by Electric Power Sector 1949 - 2005




Source: <http://www.eia.doe.gov>

# CONSERVATION FACTS

- Replacing one incandescent light bulb with a compact fluorescent lamp saves 500 pounds of coal and over ½ ton of CO<sub>2</sub> emissions.
- If one in 10 homes used **ENERGY STAR**<sup>®</sup> qualified appliances, the environmental benefit would be like planting 1.7 million acres of trees.
- If everyone reduced their driving speed from 65 to 55 mph, we'd save three-million gallons of gas a day.



*Smithsonian Magazine, September 2006, Chevron Human Energy, pg 15*



**Now that you know more  
about our energy let's talk  
about what all things are  
made up of...**



**That's right**

**-- atoms and molecules!**

**Molecules are made up of atoms. Atoms are made up of protons, electrons, and neutrons.**



**Okay, we're ready to  
start our first lesson...**

## Some web sites to research:

<http://www.eia.doe.gov/kids/energyfacts/sources/electricity.html>

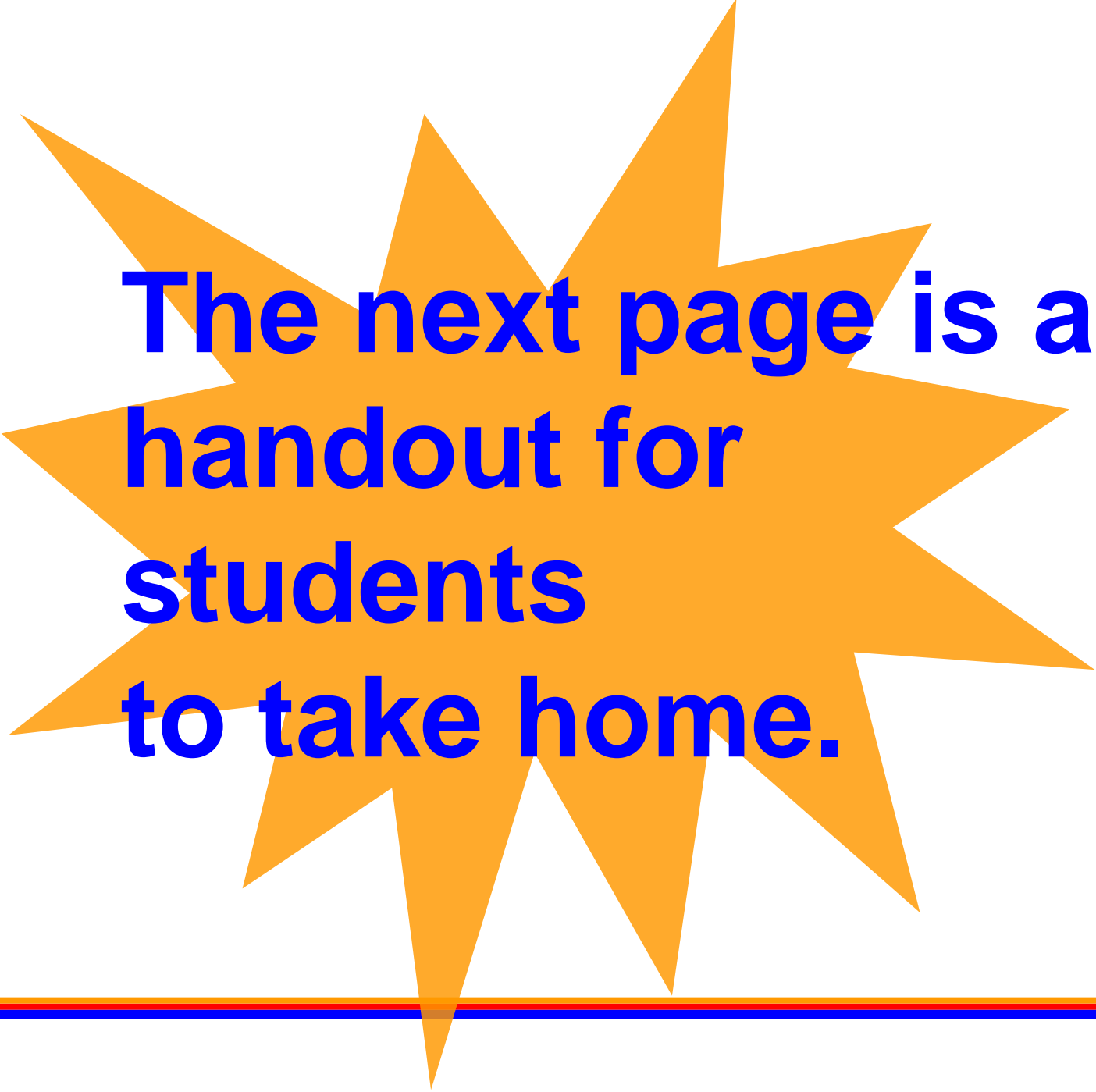
<http://www.epa.gov/globalwarming/kids/>

<http://www.britannica.com/search?query=energy&submit=Find&source=MWTEXT>

<http://www.wordcentral.com/>

<http://www.balancedenergy.org/abec/>

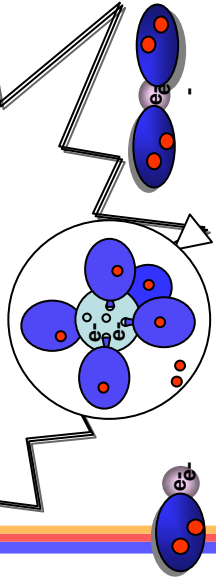
[http://www.eia.doe.gov/emeu/states/\\_multi\\_states.html](http://www.eia.doe.gov/emeu/states/_multi_states.html)



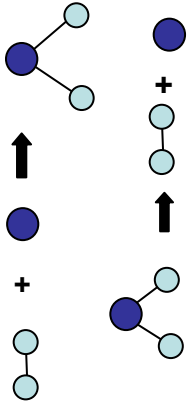
**The next page is a  
handout for  
students  
to take home.**



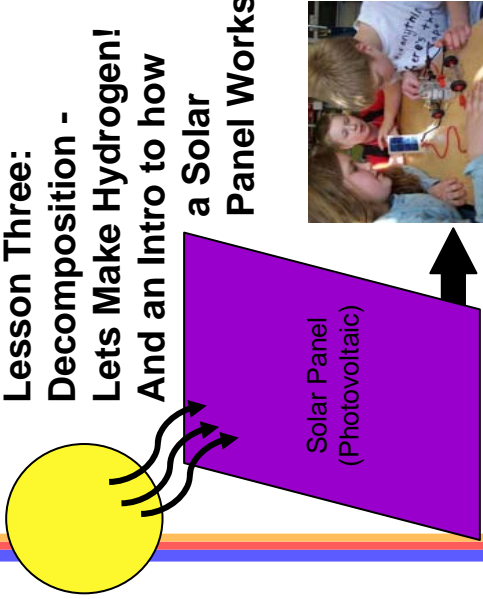
## Lesson One: Intro to the Periodic Table and 3-D Atomic Model



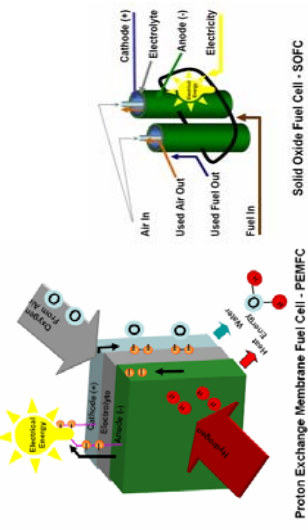
## Lesson Two: Composition Lets make Salt and Water!



## Lesson Three: Decomposition - Lets Make Hydrogen! And an Intro to how a Solar Panel Works



## Lesson Four: Introduction to Fantastic Fuel Cells



## Lesson Five: Learn About Exothermic And Endothermic Reactions

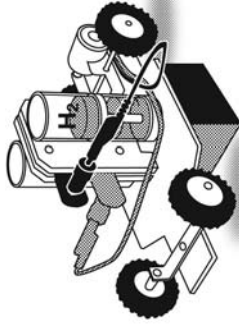


President  
Bush  
with  
fuel cell  
powered  
Camcorder

## Lesson Six:

### Critical Thinking

Observe – Record  
Measure – Record  
Compare and Predict



**End of Pre-Activity Lesson**