


Is the relatively small amount of hydroelectric power produced in Indiana worth the environmental trade-off?

WAKE the Water 2:
Kathy Daniels,
Andrew Grismore,
Edwin A. Ramos



The background of the slide features a complex, abstract pattern. It consists of numerous overlapping, semi-transparent circles and larger, more intricate fractal-like structures. These elements are set against a dark, textured backdrop that resembles a starry night sky or a microscopic view of a material. The overall color palette is dominated by dark blues, greys, and blacks, with occasional bright, glowing points of light that resemble stars or distant galaxies. The text is centered in a bold, blue, sans-serif font, which stands out clearly against the dark background.

Please Take a Moment to
Silence Your Cell Phones and
Laptop Computers

Investigating the question “**Is the relatively small amount of hydroelectric power produced in *Indiana* worth the environmental trade-off?**”

- 1) What is hydroelectric power? **4 types** (Andrew)
- 2) Indiana’s hydroelectric power and why Indiana has such a small amount, relative to other parts of the US and world. (Kathy)
- 3) Conclusion: Room for future investigations (Edwin)

Four Types of Hydroelectric Power

1) Dams

2) Diversion (Run of River)

3) Pump Storage

4) Tidal Power

Electrical Generation

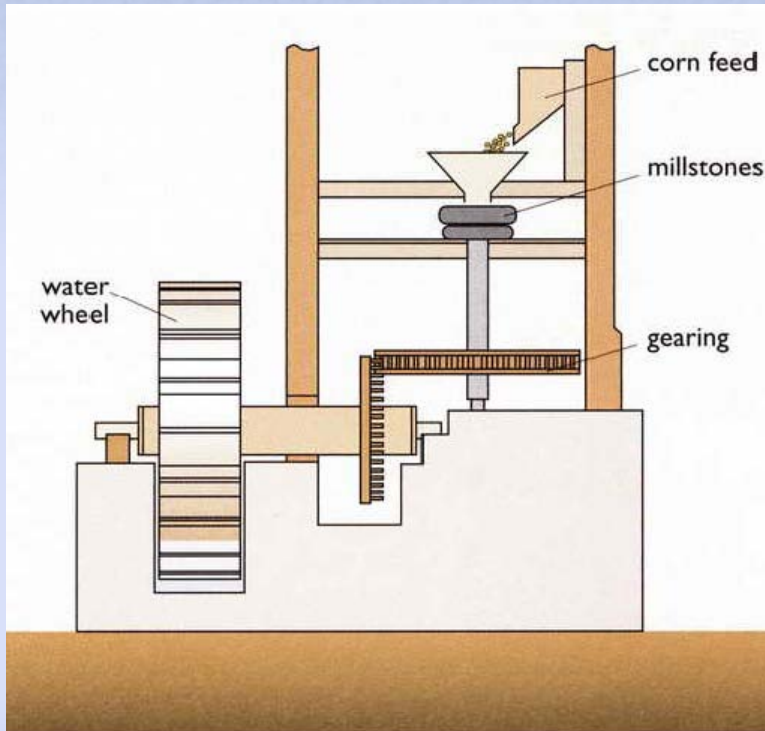
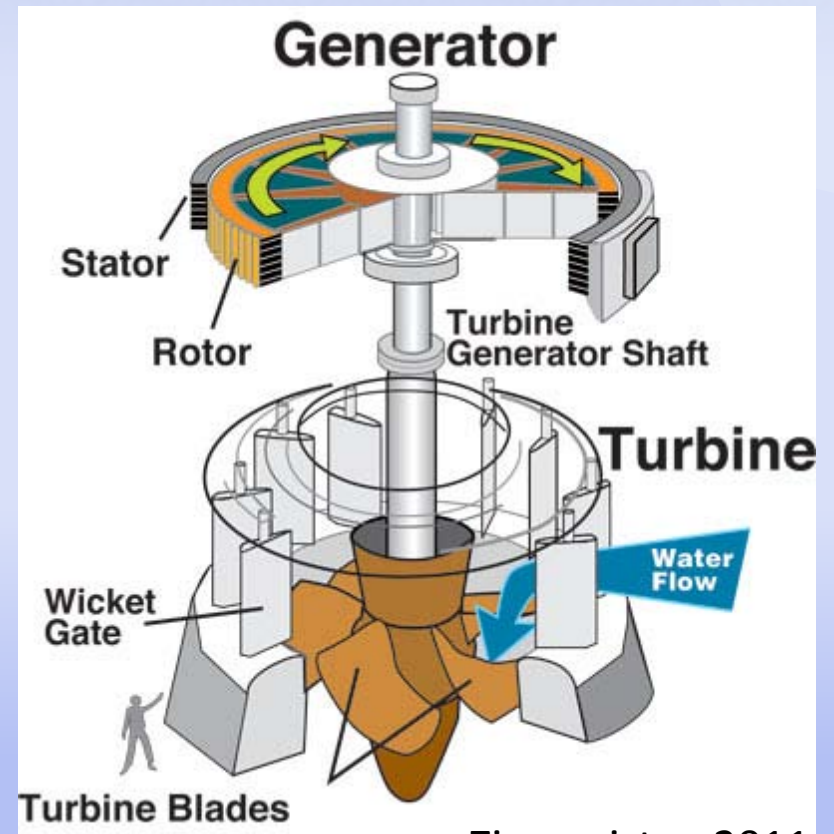


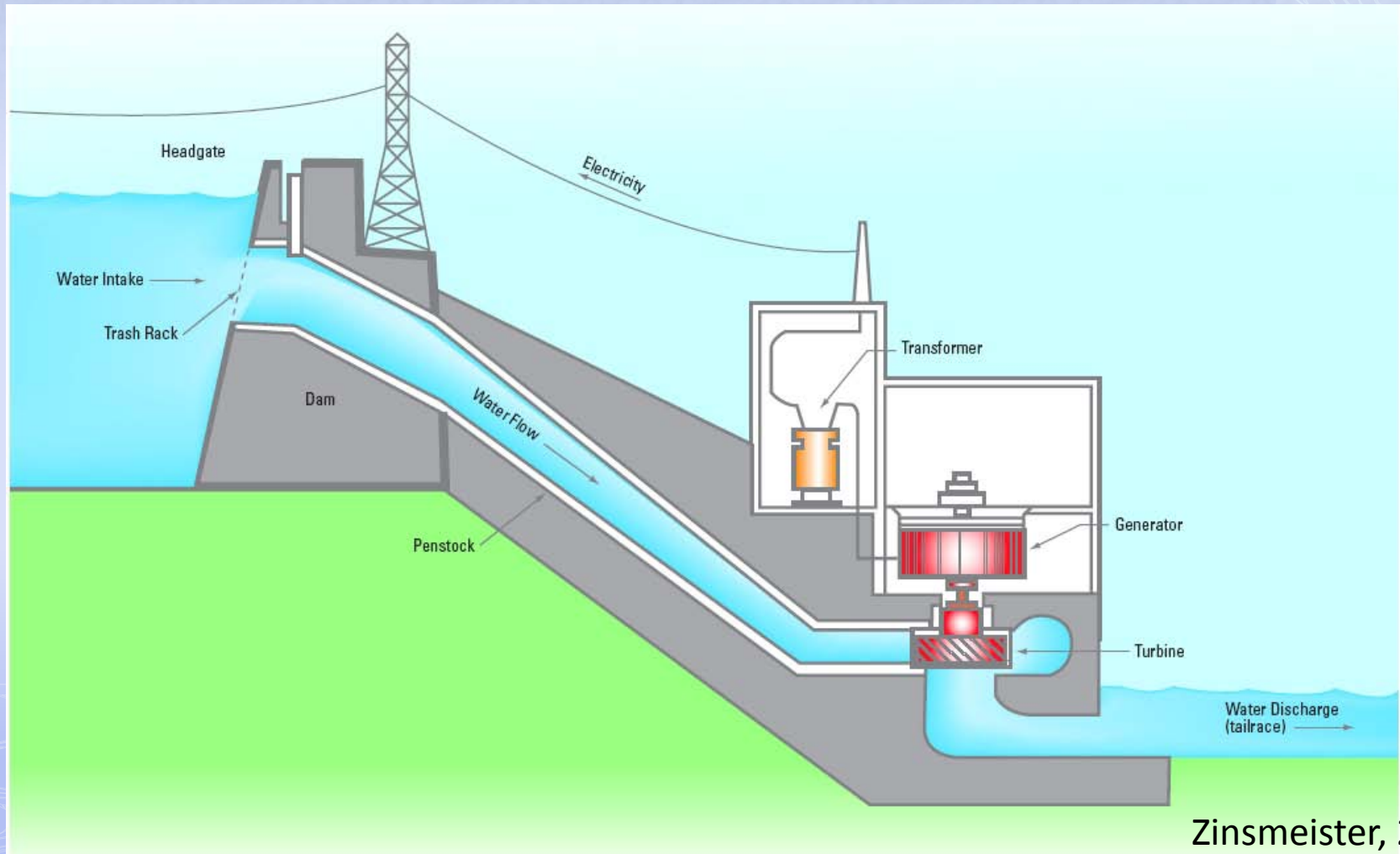
Figure 5.7 A Roman mill. This corn mill with its horizontal-axis wheel was described by Vitruvius in the first century BC. Note the use of gears

Boyle, *Renewable Energy*, 2nd edition, Oxford University Press, 2003



Zinsmeister, 2011

Dams



Zinsmeister, 2011

Diversion (Run-of River)



Pumped Storage System

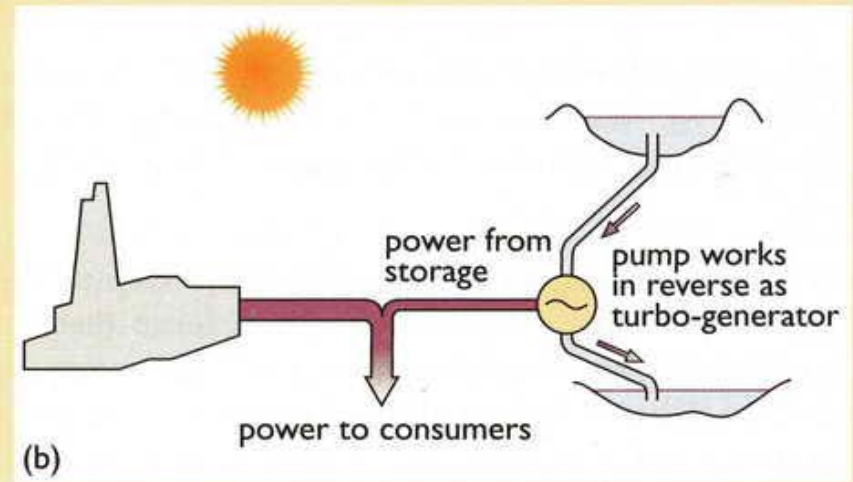
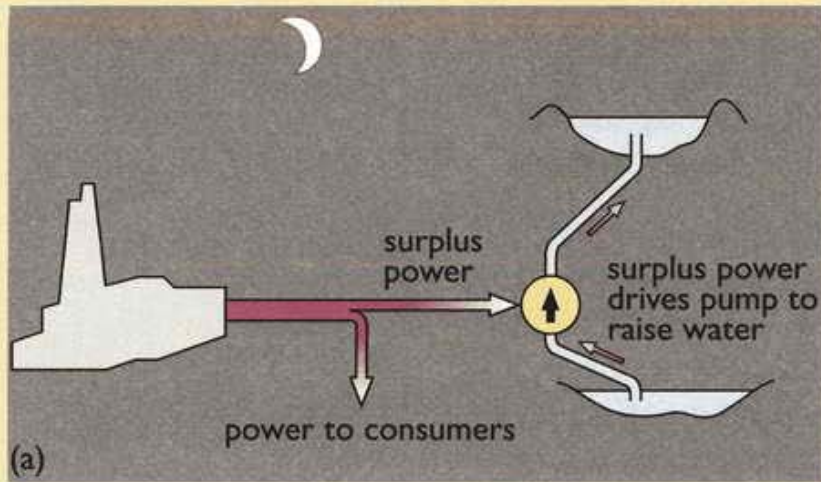


Figure 5.27 Pumped storage system: (a) at time of low demand; (b) at time of high demand

Boyle, *Renewable Energy*, 2nd edition, Oxford University Press, 2003

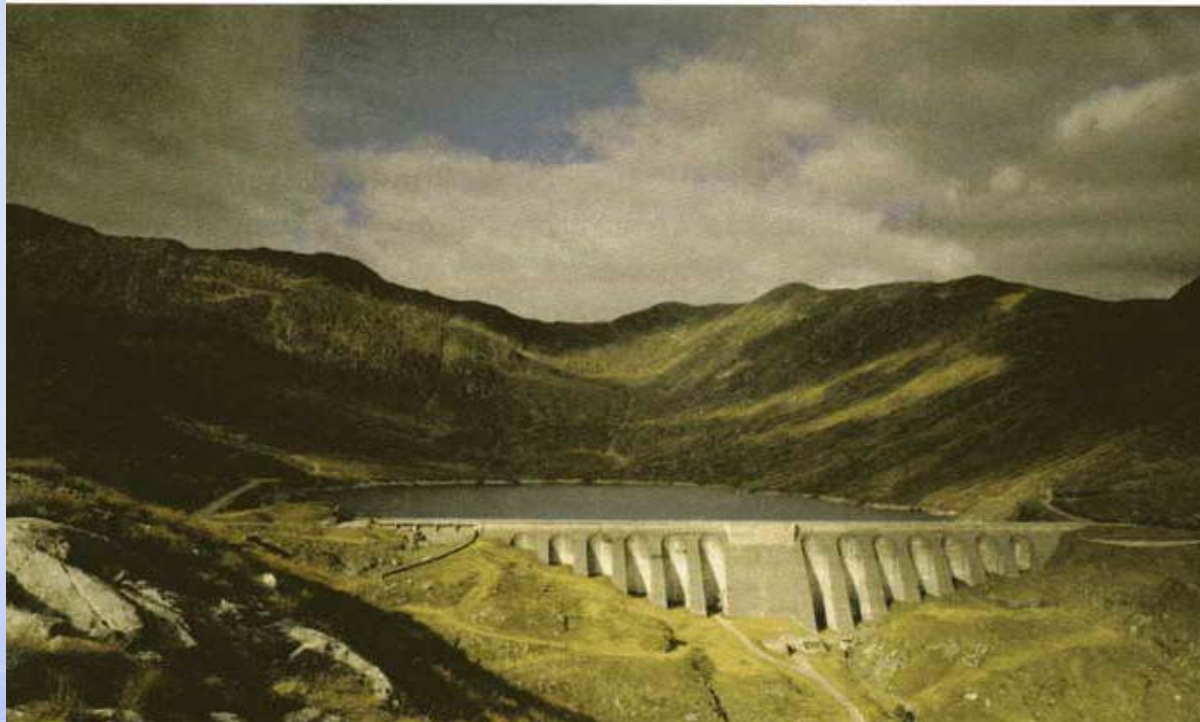
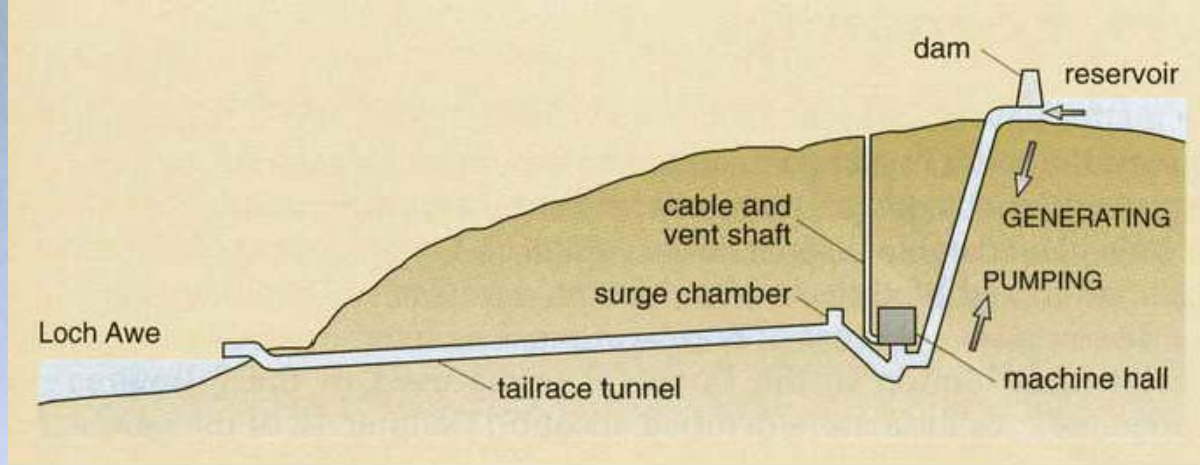
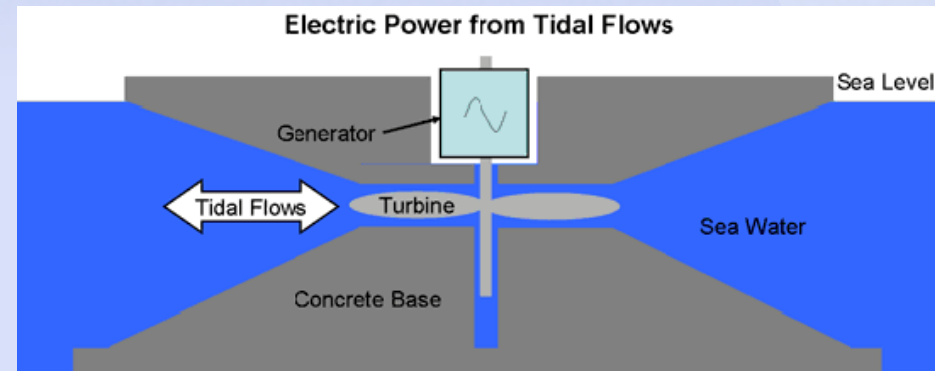
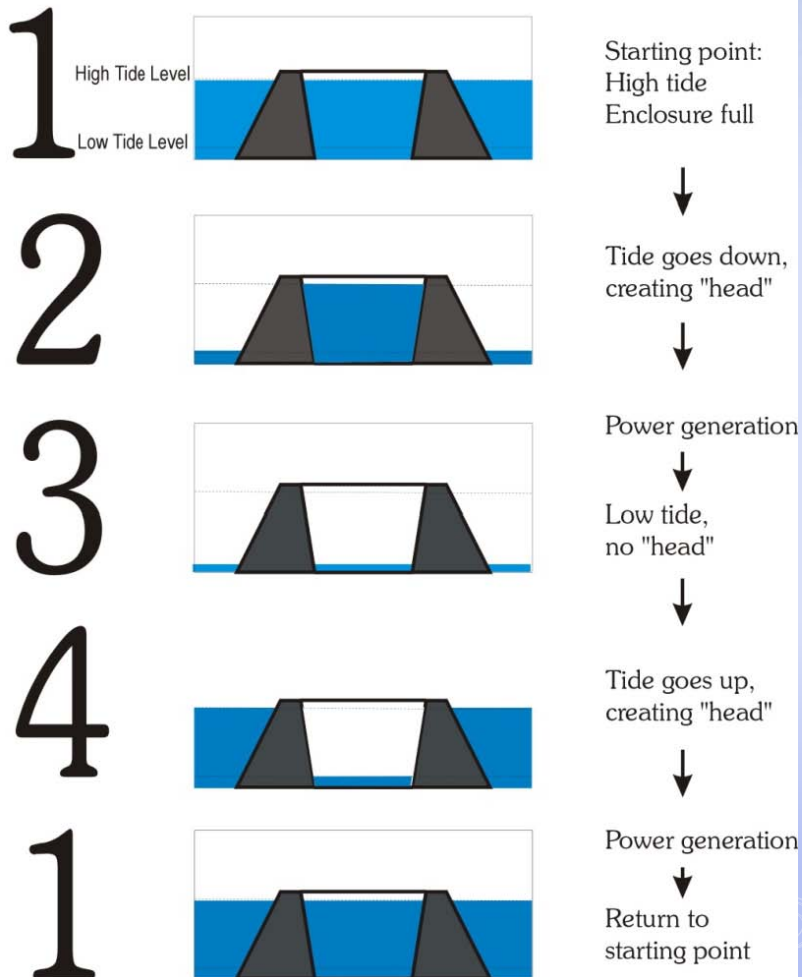


Figure 5.28 Cruachan pumped storage plant. The reservoir of this Scottish plant, commissioned in 1965, can store 10 million cubic metres of water at an operating head of about 370 m. Running the four 100 MW reversible machines for an hour at full capacity, as electric pumps or turbo-generators, raises or lowers reservoir level by about a metre. (top) the installation; (bottom) the dam

Tidal Power

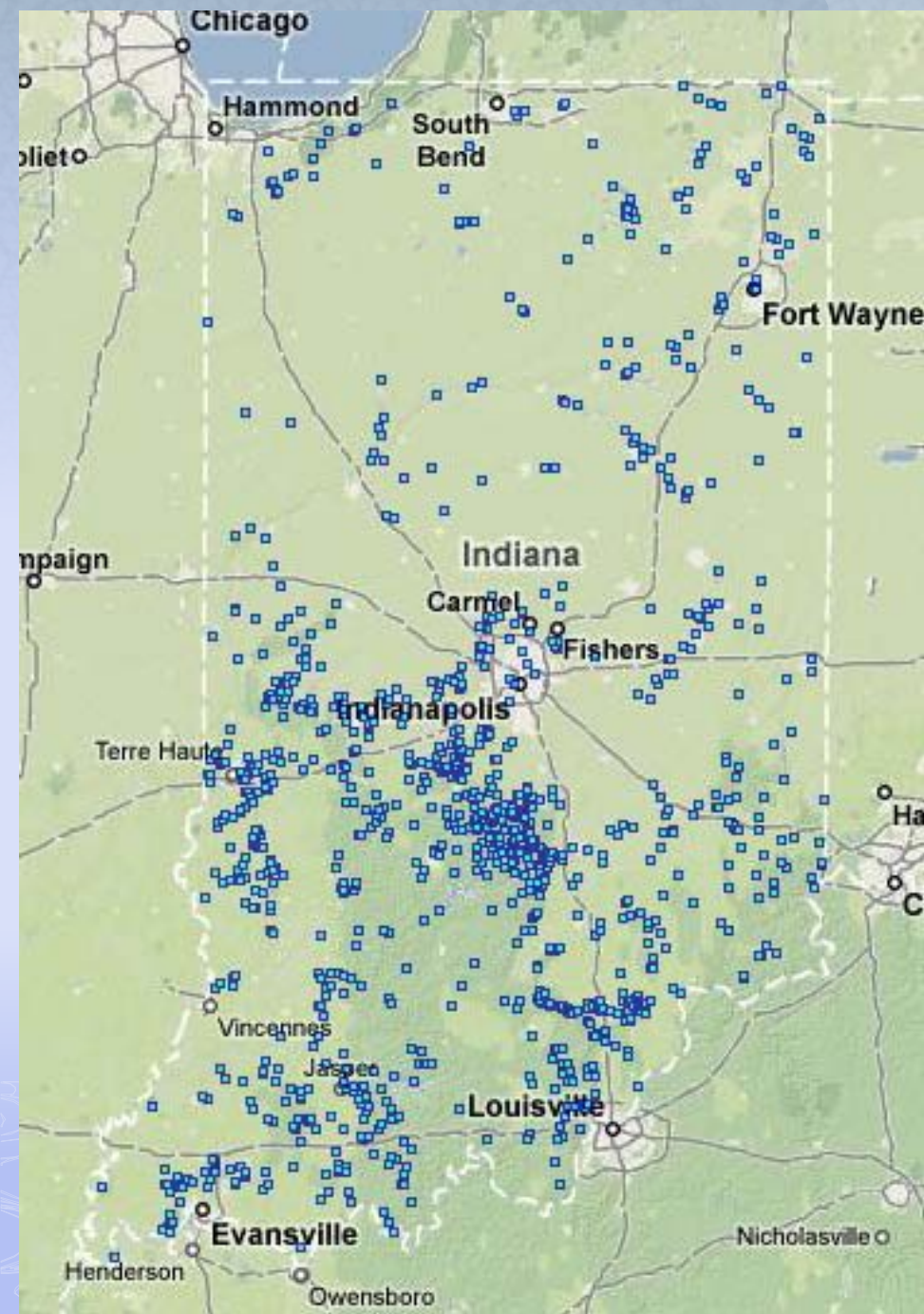
Power Generation Cycle



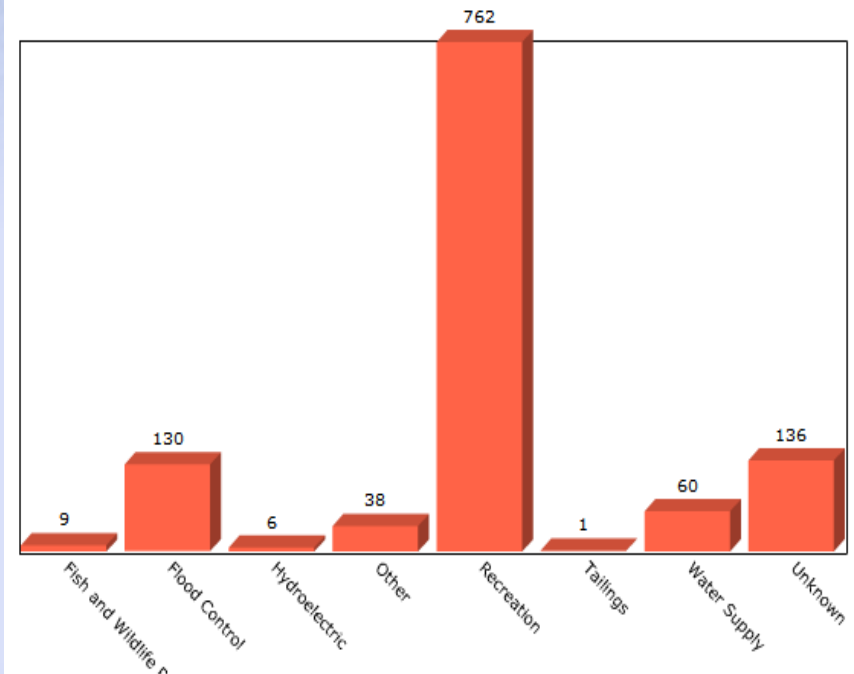
Indiana Use

- ❑ Dams
- ❑ Only 6 dams located in Indiana (IDNR, 2007)
- ❑ 4 additional dams located in Michigan produce energy for Indiana
- ❑ Run-of River Dams are used, but are not true diversion plants
- ❑ 103 Megawatts

Indiana Dams



Dams By Primary Purpose



<http://geo.usace.army.mil/pgis/f?p=397:12:777468633468577>

<http://www.damsafety.org/map/state.aspx?s=14>

Monticello, Indiana



Lake Schafer, Indiana



Clarksville, Indiana



Monterey, Indiana

Algae Pond



What we discovered...

- ❑ Water has long been used as a source of energy, beginning with the Greeks use of water wheels over 2,000 years ago.
- ❑ For over a century, hydropower has been used to generate electricity from falling water.
- ❑ + Hydropower is considered to be a clean, renewable source of energy, emitting a very low level of greenhouse gases when compared to fossil fuels.
- ❑ + It has a low operating cost once installed and can be highly automated. An additional benefit is that the power is generally available on demand since the flow of water can be controlled.

• <http://www.enviroliteracy.org/article.php/59.html>

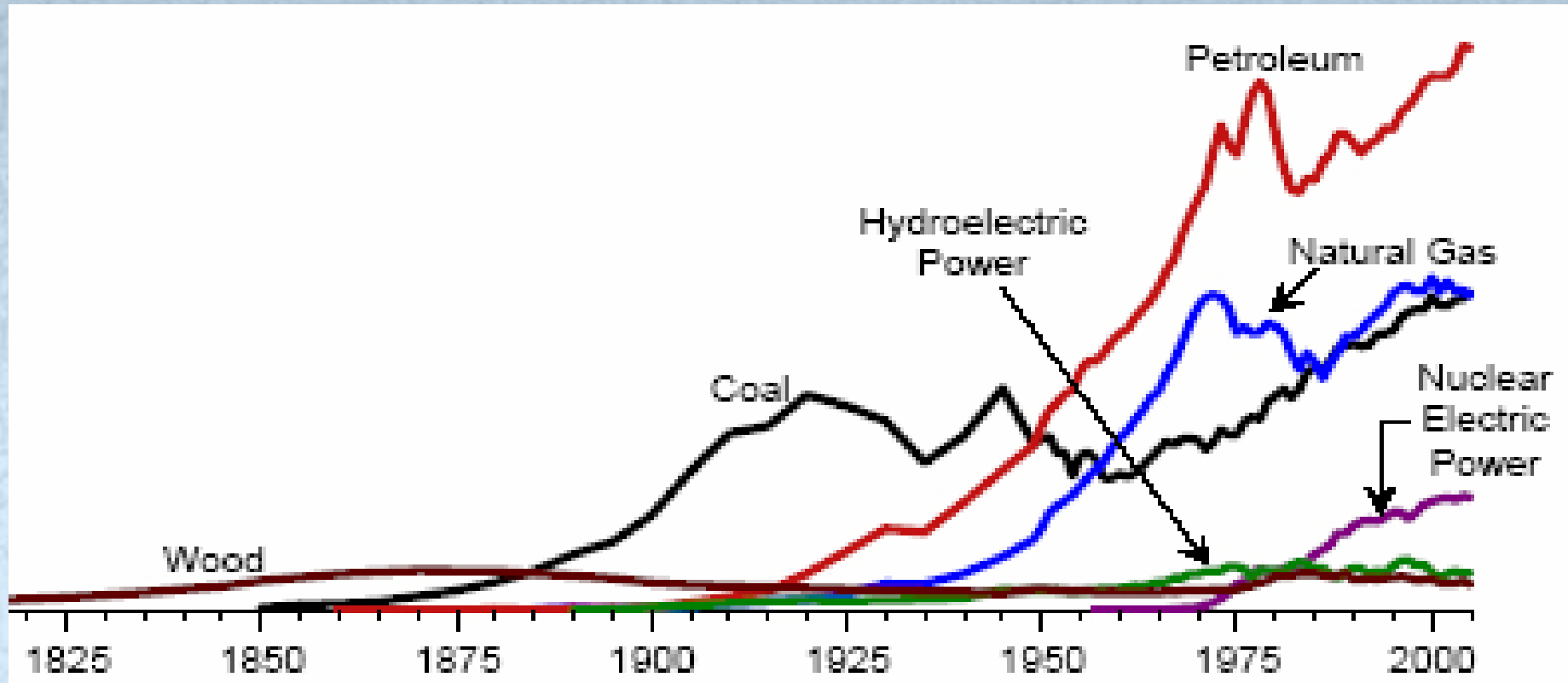
What we discovered...

- ❑ - Dams can block fish passage to spawning grounds or ocean.
- ❑ - The diversion of water can impact stream flow, or even cause a river channel to dry out, degrading both aquatic and streamside habitats.
- ❑ - Hydroelectric plants can also have an impact on water quality by lowering the amount of dissolved oxygen in the water.
- ❑ - In the reservoir, sediments and nutrients can be trapped and the lack of water flow can create a situation for undesirable growth and the spread of algae and aquatic weeds.
- ❑ In effect man-made reservoirs convert carbon dioxide in the atmosphere into methane. This is significant because methane's effect on global warming is 21 times stronger than carbon dioxide's.

Hydroelectric Power in Indiana

- There are a few places in Indiana where hydroelectricity is being produced and environmental impact is low.
- Our conclusion is while hydroelectric power is a clean and efficient source of renewable energy, it requires certain geological and topographical characteristics. In other words, Indiana is flat which makes it less suitable for this specific type of power production.
- We would recommend research into other complimentary forms of renewable energy production if hydroelectric power is to be a part of meeting Indiana's energy demand over the next 20 years.

U. S. Energy Consumption Sources, 1635-2005



Zinsmeister, 2011

Sources of energy:

Wood = brown

Coal = black

Petroleum = red

Natural gas = blue

Hydroelectric = green

Nuclear = purple

Why even consider the environmental trade-off of hydroelectric power in Indiana?

- Students will be leaders of the future, so their decisions about energy will be key
- Combine diverse renewable energy sources: Hydroelectric, wind, biomass
- Think “retrograde functionality”
- Untapped hydroelectric potential in Indiana:
 - Rip tides of Lake Michigan (HASTI, Spring 2011)
 - Fertility of stagnant water for biomass

References

Web Resources

- National Association of Regulatory Utility Commissioners
http://www.narucpartnerships.org/Documents/Regulatory_treatment_of_hydro_resources_eng_Curt_Gassert.pdf
- NewScientist Magazine
<http://www.newscientist.com/article/dn7046>
- Enviroliteracy Council
<http://www.enviroliteracy.org/article.php/59.html>
- US Army Corps of Engineers
<http://geo.usace.army.mil/pgis/f?p=397:12:777468633468577>
- Lake Lubbers <http://www.lakelubbers.com/lake-shafer-479/>
- Discovery Education article on Three Gorges Dam
<http://www.discoveryeducation.com/teachers/free-lesson->

Any Dam Questions?



http://www.google.com/imgres?imgurl=http://www.g-mwater.com.au/images/content/hume%2520dam%25202.jpg&imgrefurl=http://www.g-mwater.com.au/water-resources/storages/murray&usq=__gx50x_EyJeDp2rbkF7mhQ7tb2c-&h=1198&w=1800&sz=137&hl=en&start=30&zoom=1&fbid=EJafy_cdx3O-MM&tbid=125&bmw=166&cl=gR36Tdr2DM2SgQIShu3x3Dw&prev=/search%3Fq%3Ddam%26h%3Den%26sa%3DX%26rs%3Dcom.microsoft.en-us.IE-SearchBox%26rlz%3D117GGLL_en%26biw%3D1004%26bih%3D588%26bm%3Disch&lbs=1&iact=hc&vpx=285&vpy=294&dur=46&hovw=183&hovw=2753bx=160&ty=175&page=3&ndsp=15&ved=1t:429r:1s:30&biw=1004&bih=588