



Environmental
Impacts of Technology

The Production of Electricity

Power from Water

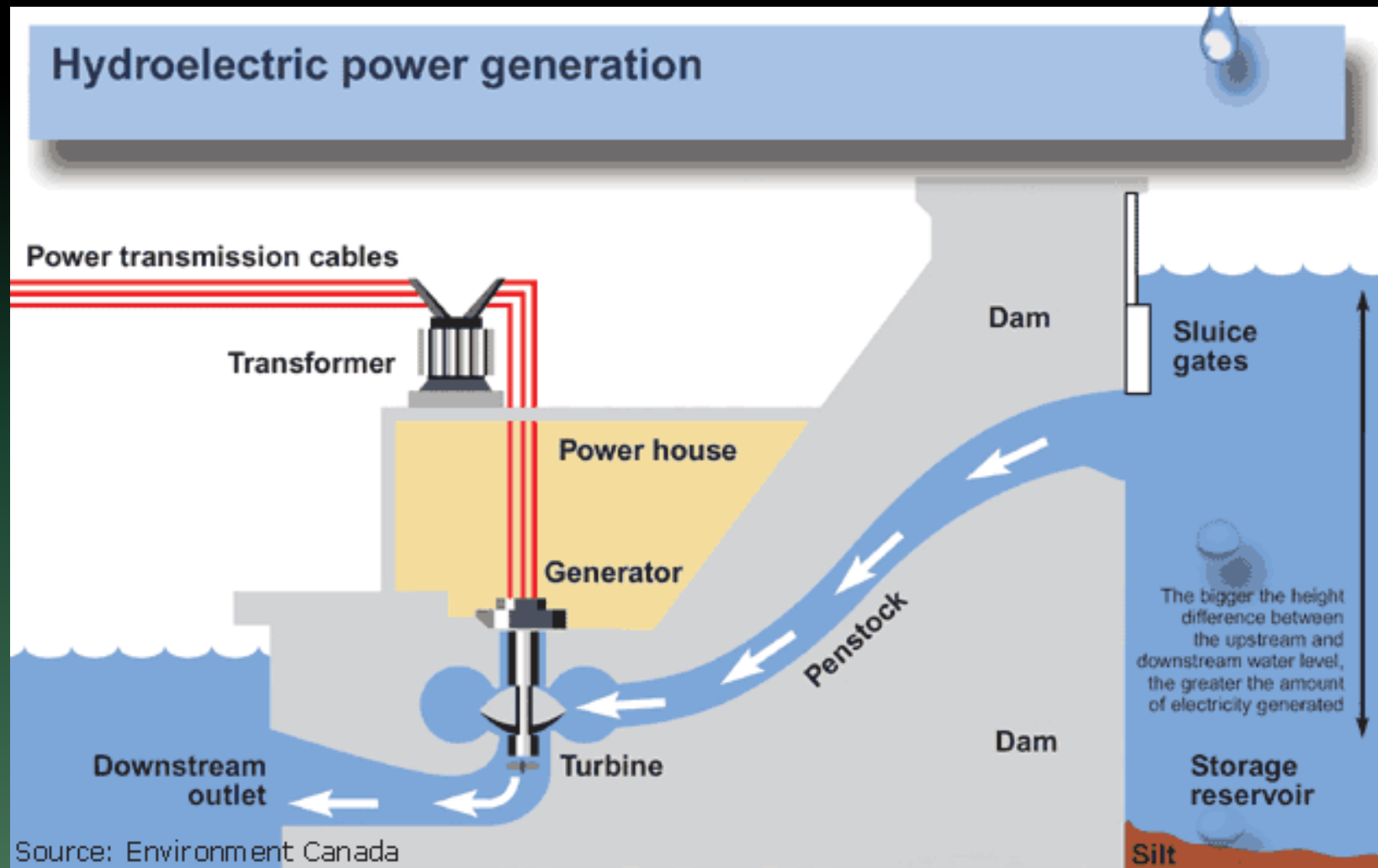


Image Source: Farwestern / Gregg M. Erickson

HydroElectricity

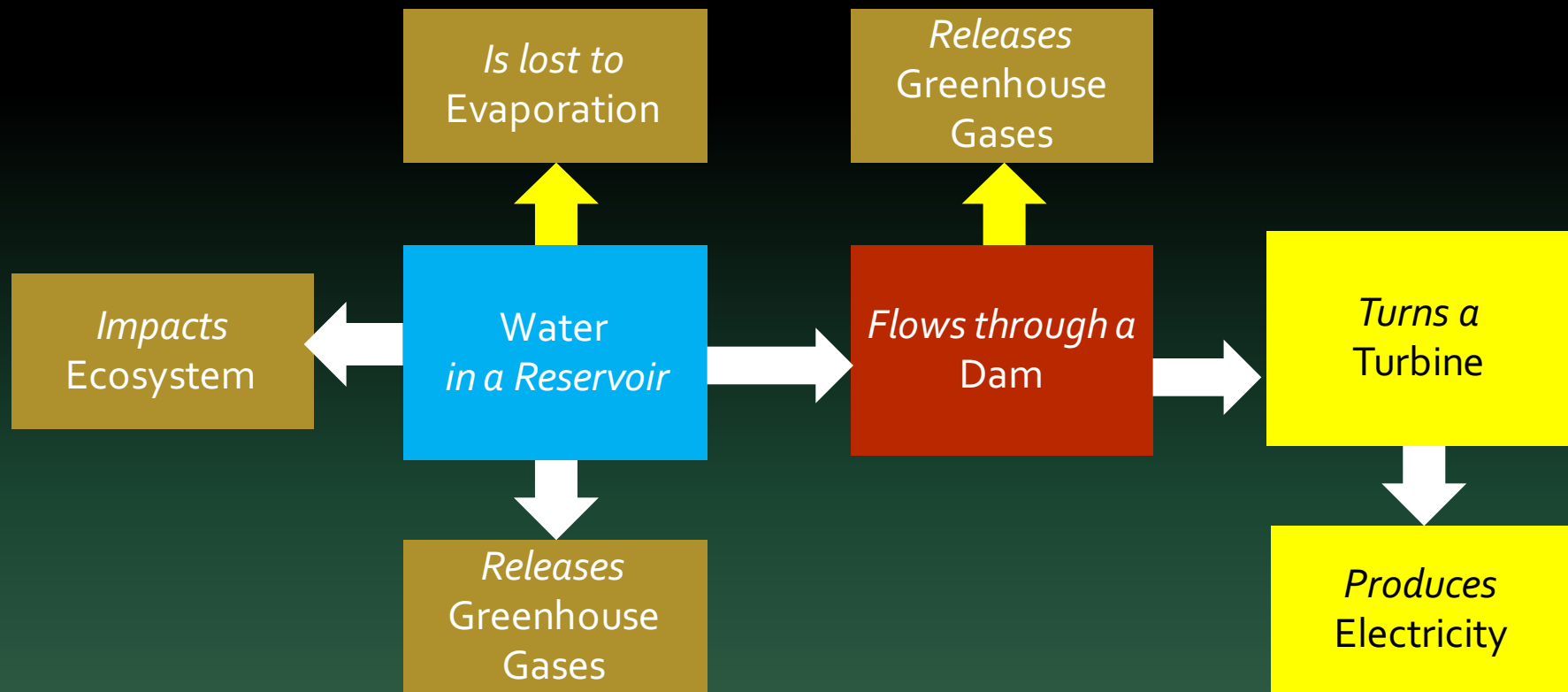
How does it work?

Conventional Hydroelectric Plants



Producing Electricity from Water

How does it work?



In the Conventional Hydroelectric Plant:

1. Water is stored in a Reservoir behind a dam.
2. Water flows into a turbine near the bottom of the dam, turning the turbine blades.
3. The rotating blades produce electricity.

HydroElectricity

How does it work?

Pumped Storage Hydroelectric Plants

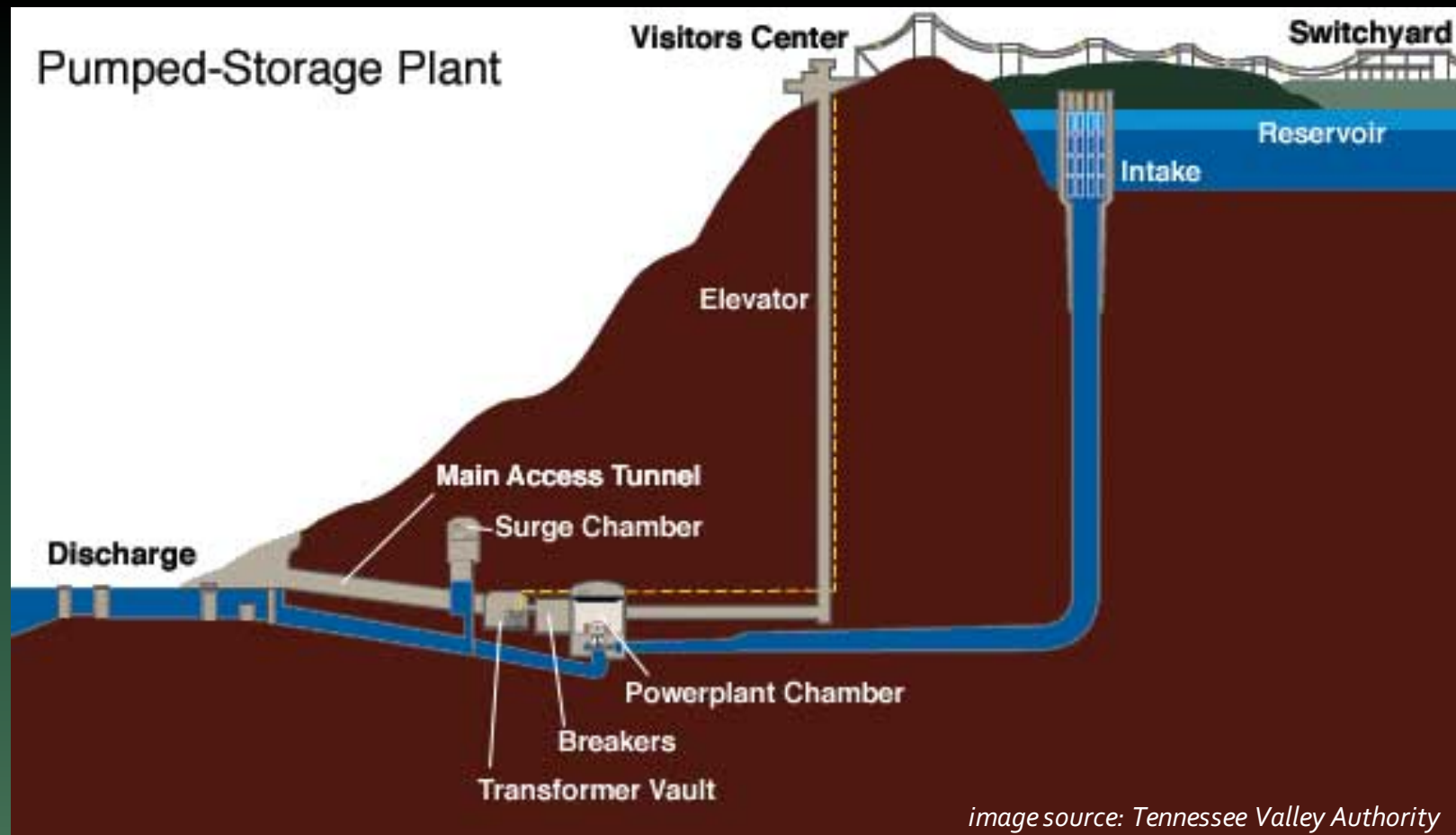
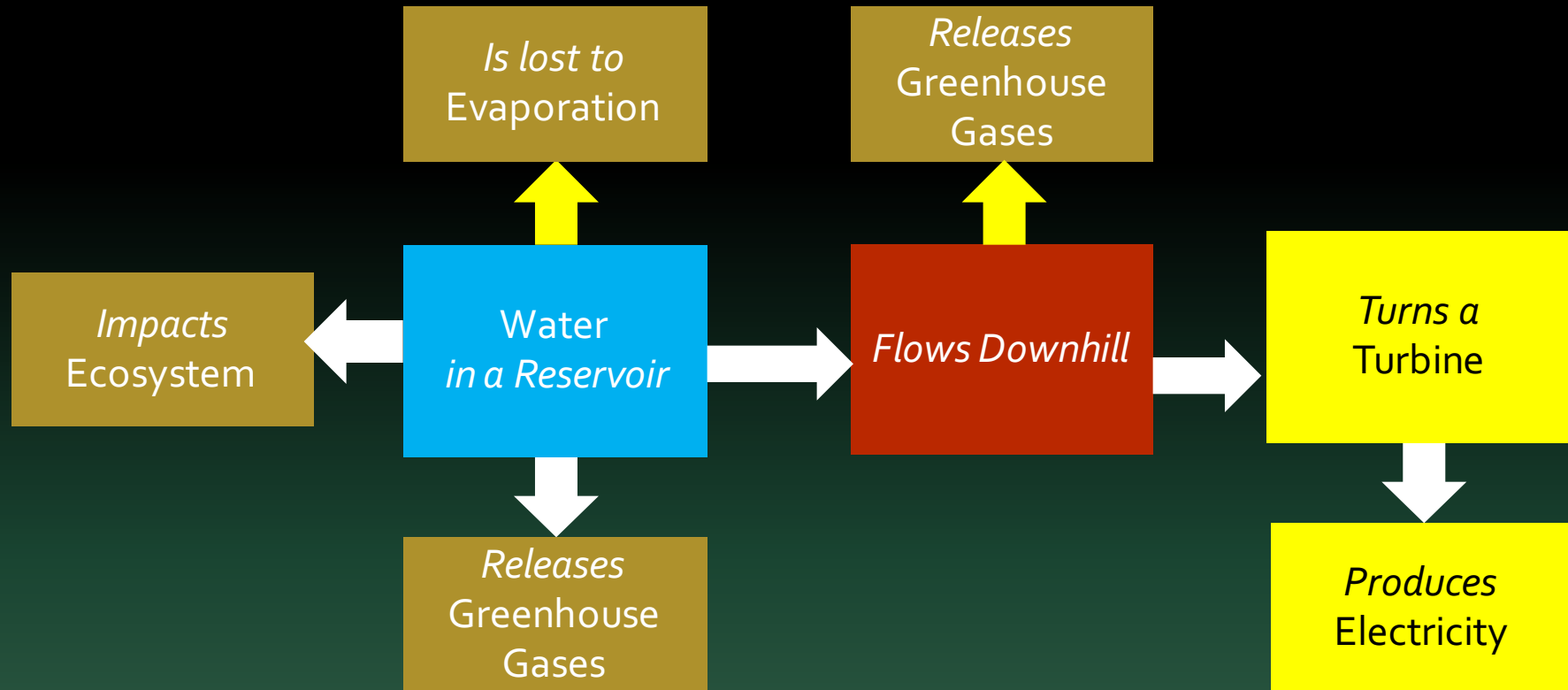


image source: Tennessee Valley Authority

Producing Electricity from Water

How does it work?



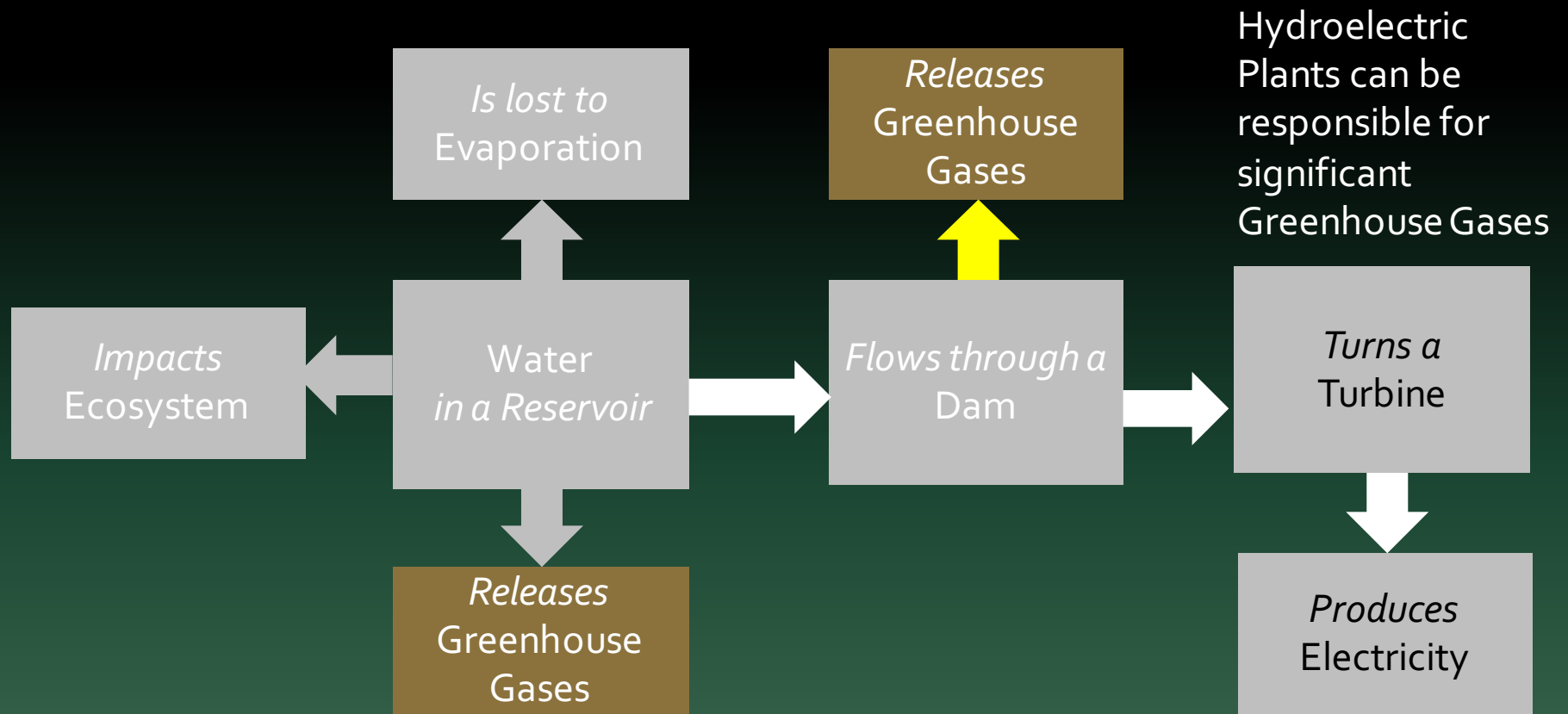
In the Pumped Storage Hydroelectric Plant:

1. Water is pumped into a reservoir at higher elevations during non-peak hours.
2. Water flows from the reservoir into the turbines during peak hours.
3. The turbines produce electricity.

Although this process consumes electricity, it makes a profit by trading non-peak power (consumed) with peak power (generated).

Producing Electricity from Water

How does it impact the environment?



A typical hydroelectric power can generate 0.5 lbs. of CO₂ per kilowatt-hour (compared to 0.6-2 lbs. for natural gas burning and 1.4-3.6 lbs. for coal burning). Some hydroelectric power plants can produce 2 to 3 times the greenhouse gases of natural gas burning plants!

Producing Electricity from Water

How does it impact the environment?

Hydroelectric Plants can be responsible for significant Greenhouse Gases emissions.

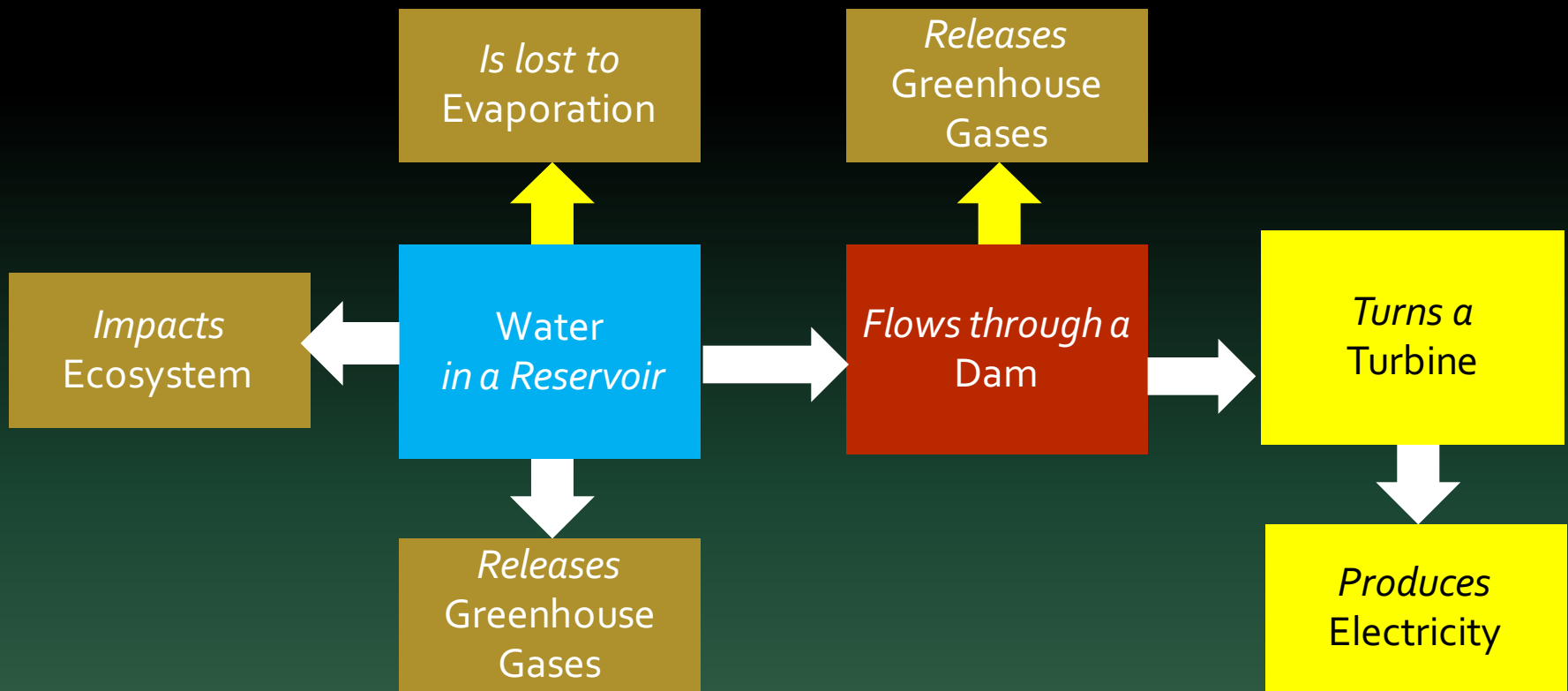
- Carbon dioxide is released by plants and trees destroyed during the damming process.
- Dissolved methane builds up from decomposing plants at the bottom of the reservoir that results from initial damming; the methane is released into the air as a potent greenhouse gas as water flows through the dam.
- Carbon dioxide is released by plants growing and dying along the sides of the reservoir during seasonal drawdown and refill cycles in the reservoir.



Image Source: PRA

Producing Electricity from Water

How does it impact the environment?



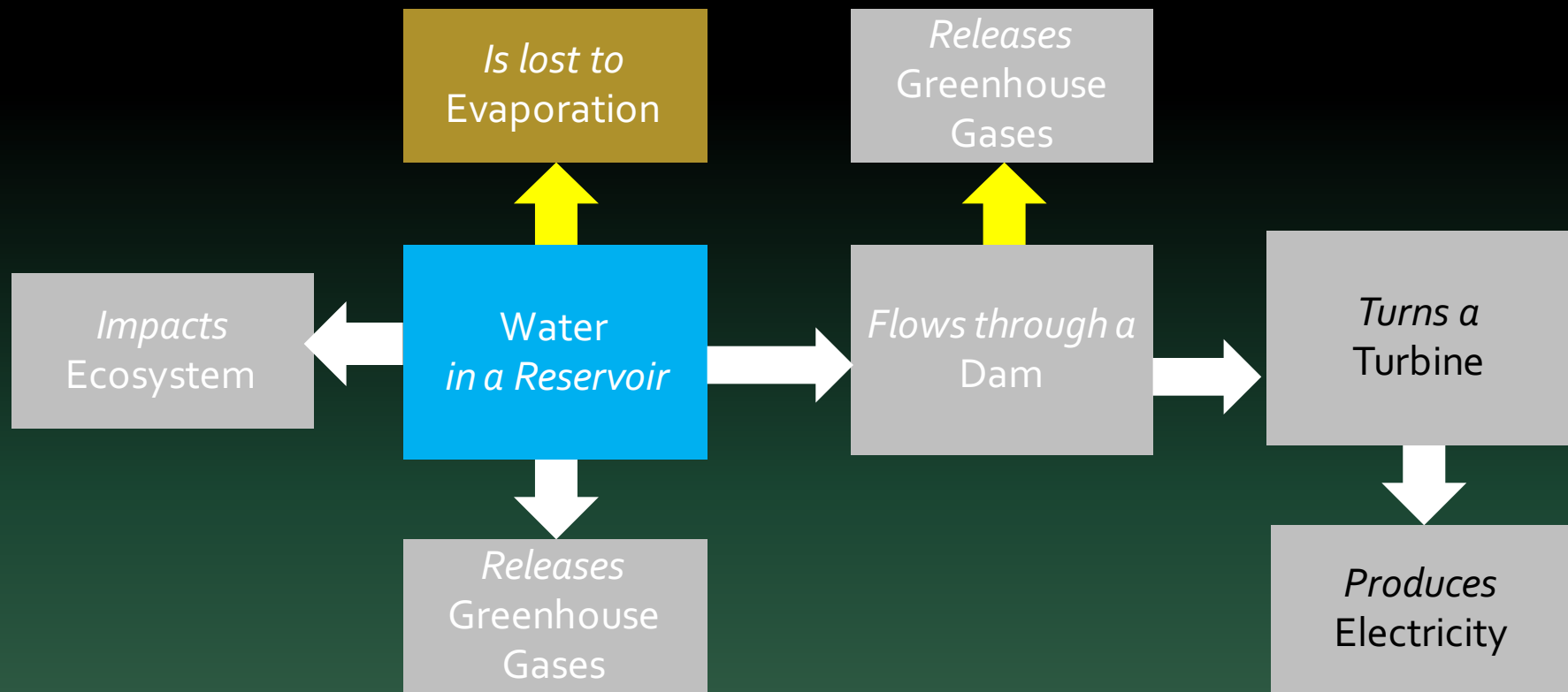
Air Quality impacts associated with coal and natural gas plants are negligible in hydropower.



- Zero Heavy Metal (e.g. lead, arsenic, mercury) emissions
- Zero Sulfur Dioxide emissions
- Zero Nitrogen Oxide and Nitrous Oxide emissions

Producing Electricity from Water

How does it impact the environment?



While all hydroelectric power plants use a great deal of water, the amount they consume varies widely, making it difficult to quantify overall water consumption.

Producing Electricity from Water

How does it impact the environment?

How much water is “consumed” by evaporation from reservoirs or lakes associated with hydroelectric plants depends on:

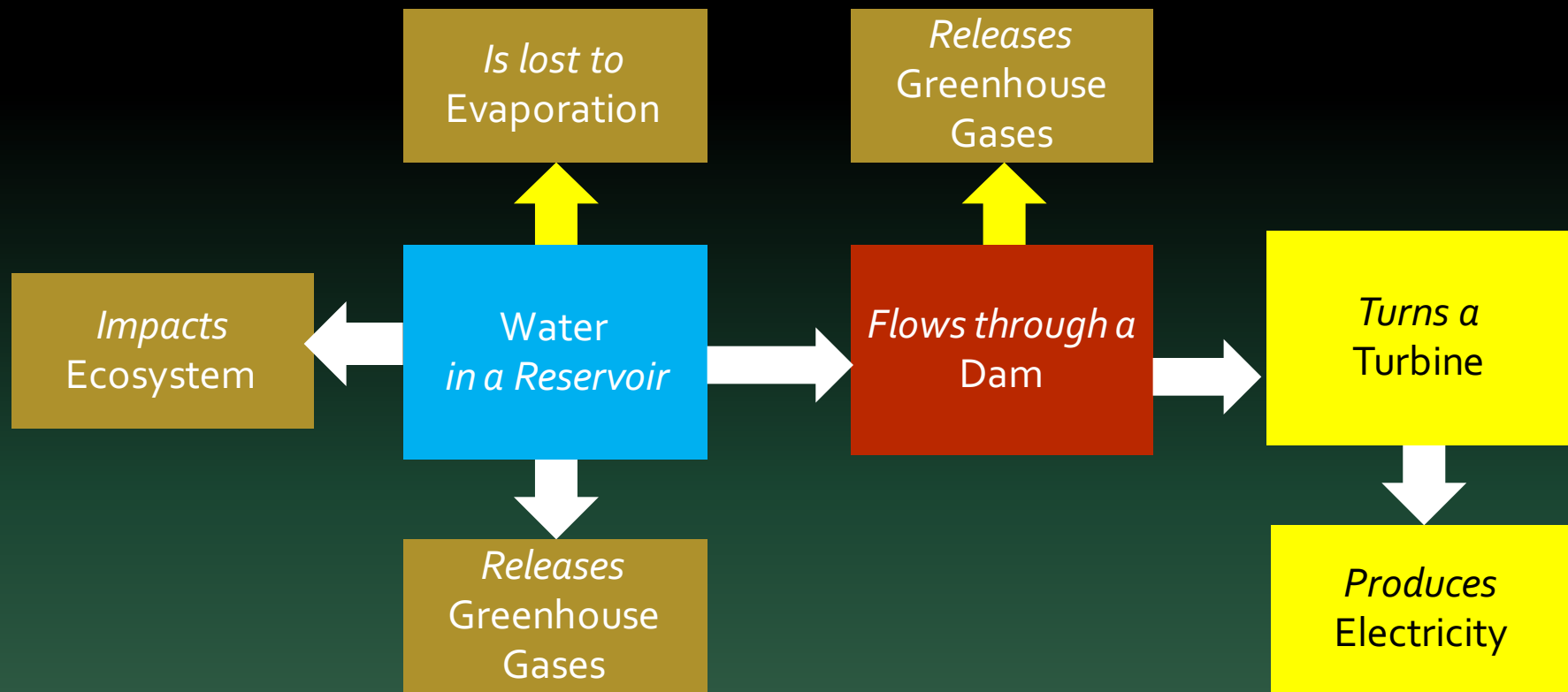


Image Source: P.hogg at EnglishWikipedia

- Whether or not the reservoir/lake which feeds the dam is artificial or natural – would the water have evaporated anyway?
- What the reservoir/lake is used for in addition to hydroelectricity (fishing, recreation, etc.) – how much evaporated or consumed water should be assigned to electricity production?

Producing Electricity from Water

How does it impact the environment?



Because large hydroelectric plants involve large reservoirs, they can harm surrounding ecosystems and habitats in many ways.

Producing Electricity from Water

How does it impact the environment?



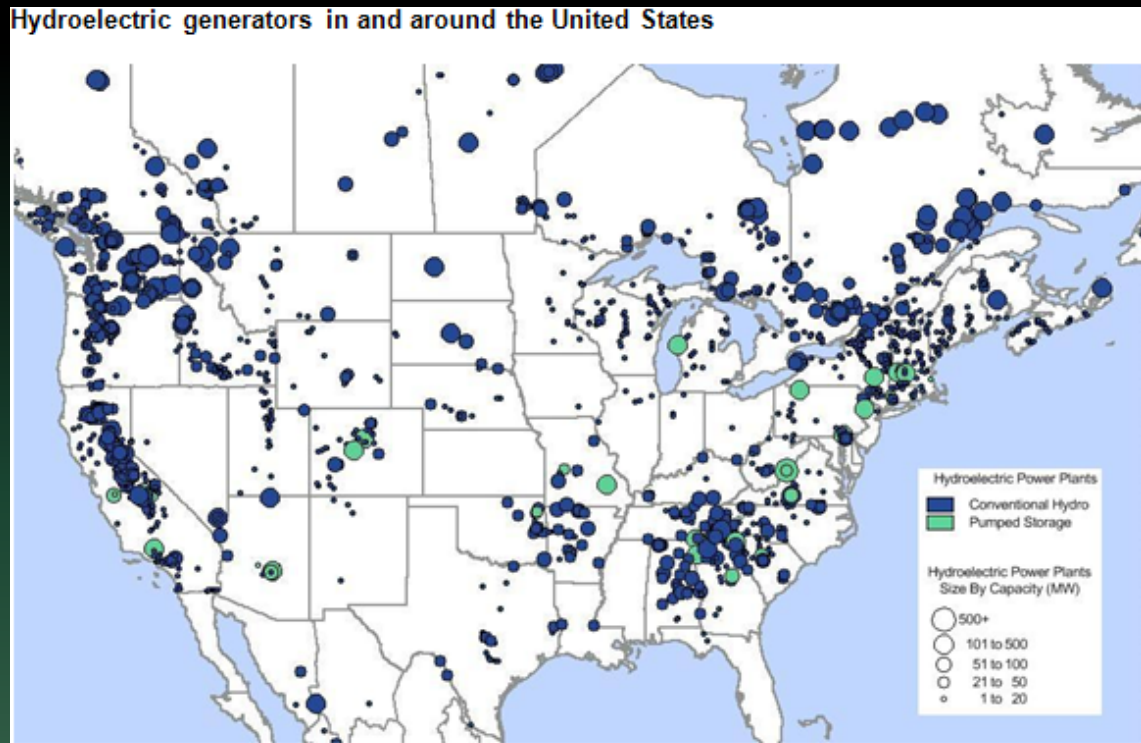
Image Source: U.S. Fish and Wildlife Service

Flooding land to facilitate hydroelectric power destroys wildlife, forest, agricultural, and other lands. Reservoir water is more stagnant, colder, and contains less dissolved oxygen and nutrients – which affects life inside the reservoir and downstream when water is released. Dams prevent fish and other animals from passing through, which can have profound impacts on certain species.

Producing Electricity from Natural Gas

Why does the U.S. use hydroelectricity?

Hydroelectricity is clean*, renewable, and plentiful in certain regions of the U.S.



Source: U.S. Energy Information Administration, derived from Energy Velocity

* excluding greenhouse gas emissions

Producing Electricity from Water

What's next for the U.S.?

Although it is renewable, hydropower is complicated by indirect greenhouse gas emissions and damage to surrounding ecosystems that results from dam and reservoir construction.

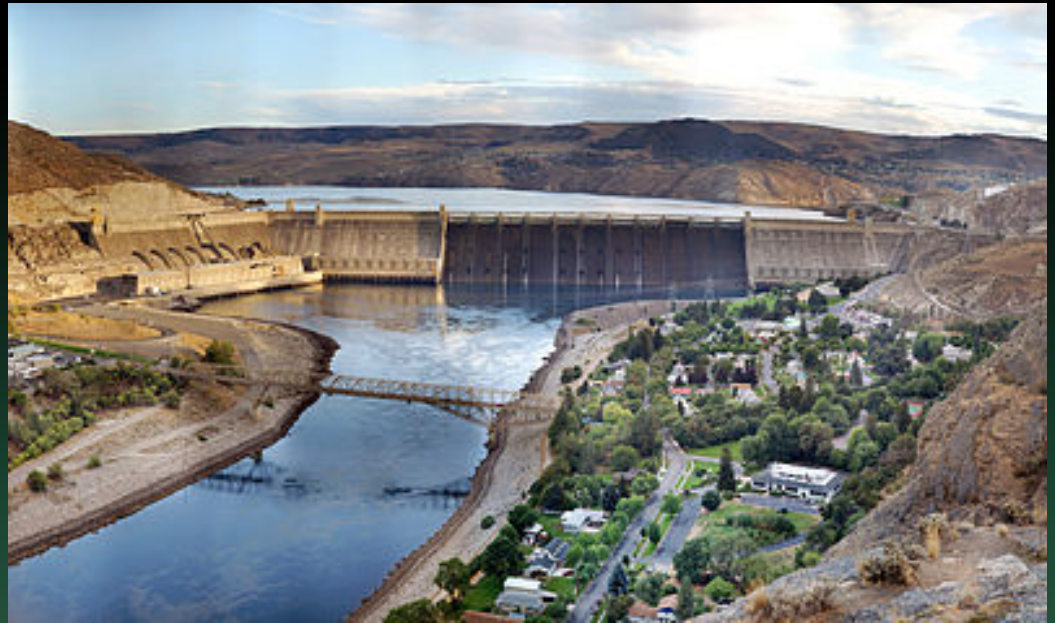


Image Source: Farwestern / Gregg M. Erickson

For the first time (in 2016), wind-based electricity generation surpassed water-based electricity generation in the U.S. While the U.S. is unlikely to build new hydroelectric facilities in the future, existing facilities will continue to produce renewable and relatively clean energy well into the future.



Environmental Impacts of Technology

Additional Impacts

<http://comingalongside.org/Technology/>

<http://labs.ee.washington.edu/community/EnvironmentallImpacts/>