



Environmental Impacts of Technology

The Production of Electricity *Power from Coal*



Image source: Greg Goebel
from Loveland CO, USA

Producing Electricity from Coal

How does it work?

A typical coal burning plant has a capacity of 500 megawatts (MW), burns over a million tons of coal each year, and produces enough electricity for about 140,000 people

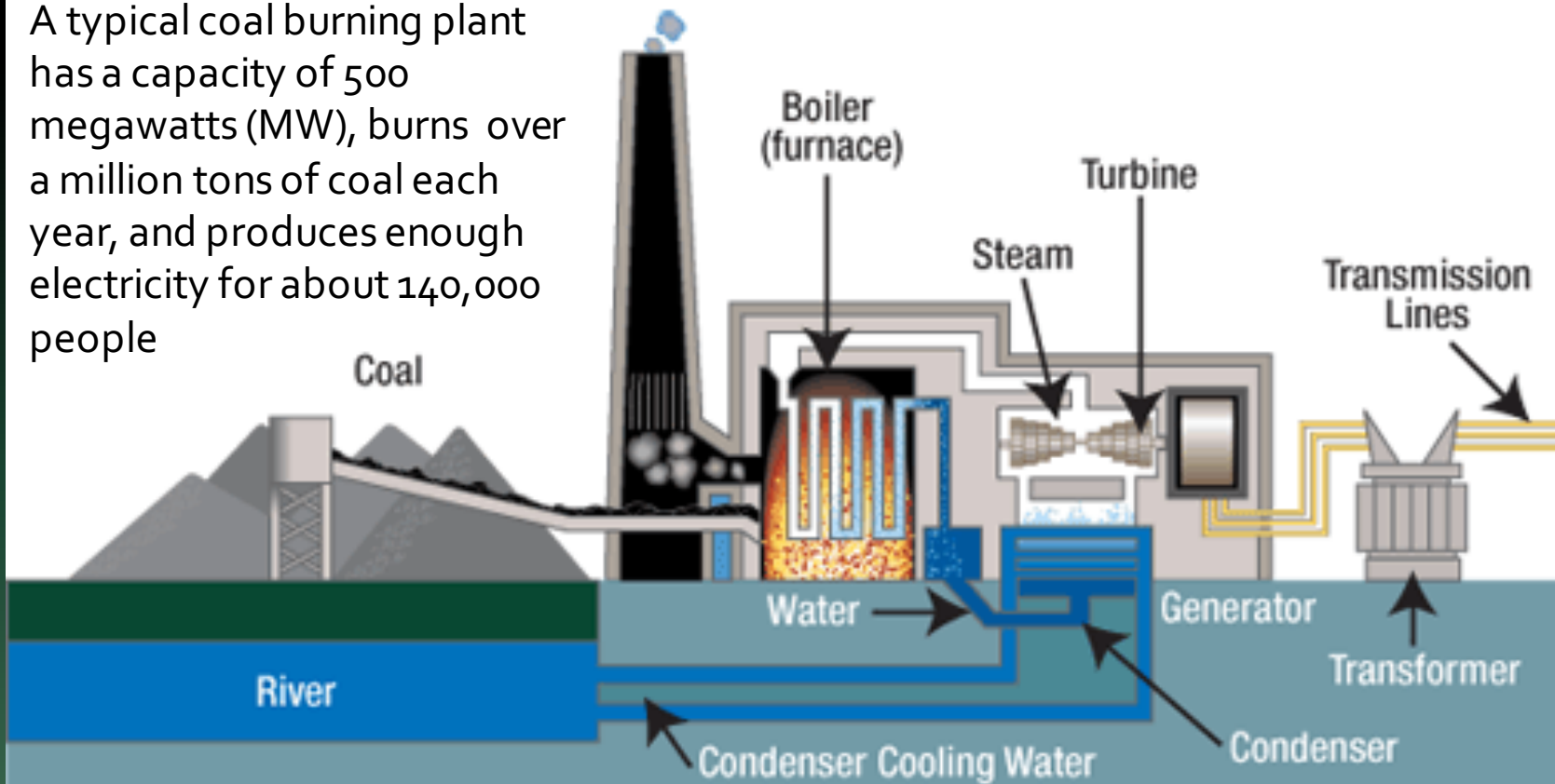
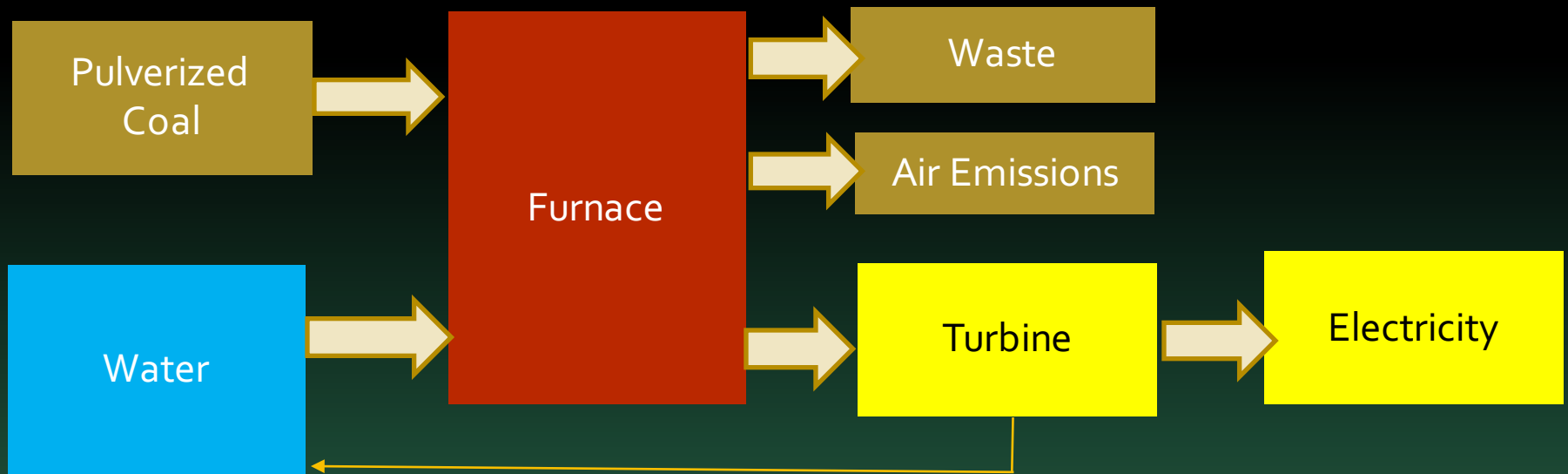


image source: Tennessee Valley Authority

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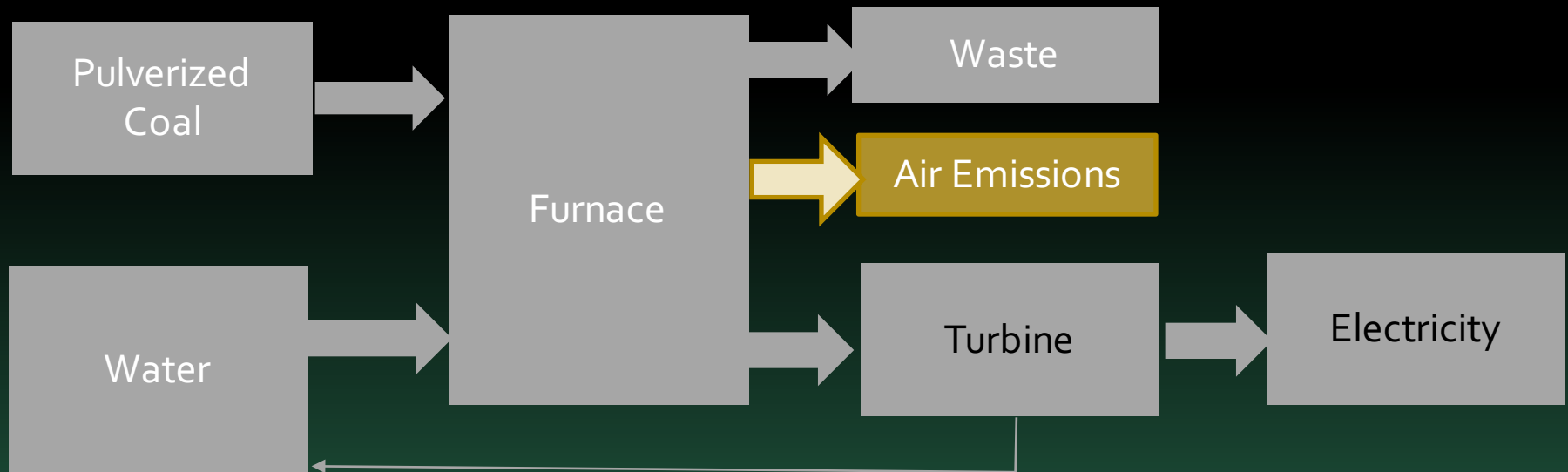


Pulverized coal is converted to electricity through the Rankine cycle:

1. The coal is blown into the furnace, becomes airborne, and is burned.
2. The heat generated from the burning heats water flowing through tubes in the furnace.
3. The water turns into pressurized steam which exits the furnace.
4. The steam turns the blades of a turbine.
5. The rotating turbine produces electricity.
6. The steam is condensed, cooled, and returned to the furnace to repeat the cycle.

Producing Electricity from Coal

How does it impact the environment?

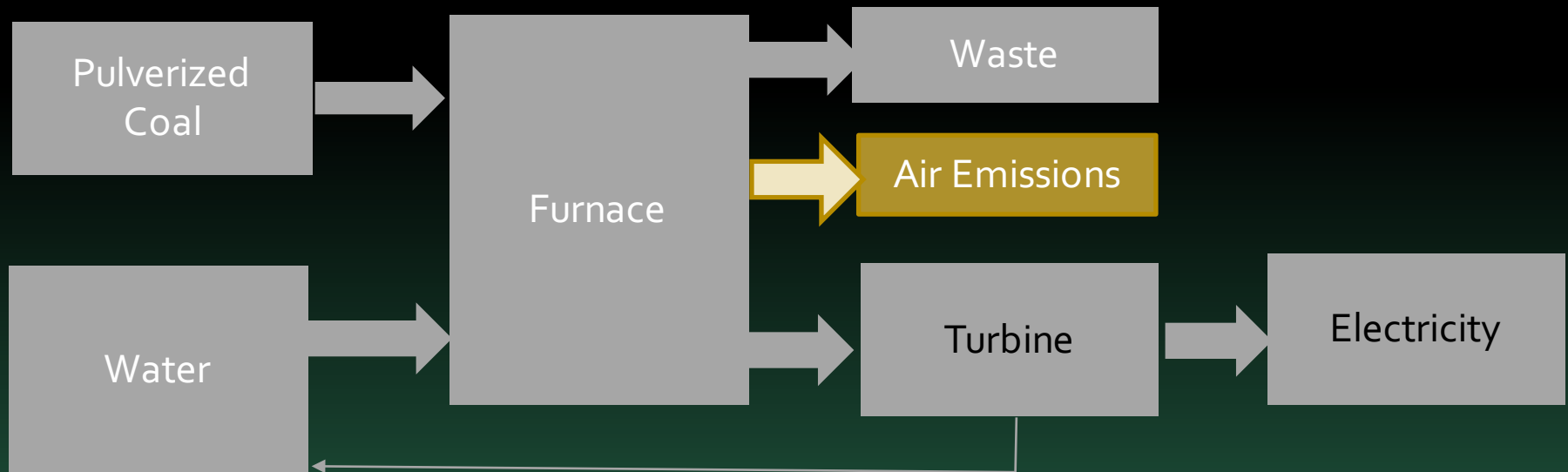


A typical 500MW coal burning plant can emit the following into the air each year:

- 10,000 tons of sulfur dioxide (leading to acid rain)
- 10,000 tons of nitrogen oxide
- 3.7 million tons of carbon dioxide
- 500 tons of small particles
- 720 tons of carbon monoxide
- 125,000 tons of ash
- 225 pounds of arsenic and 114 pounds of lead

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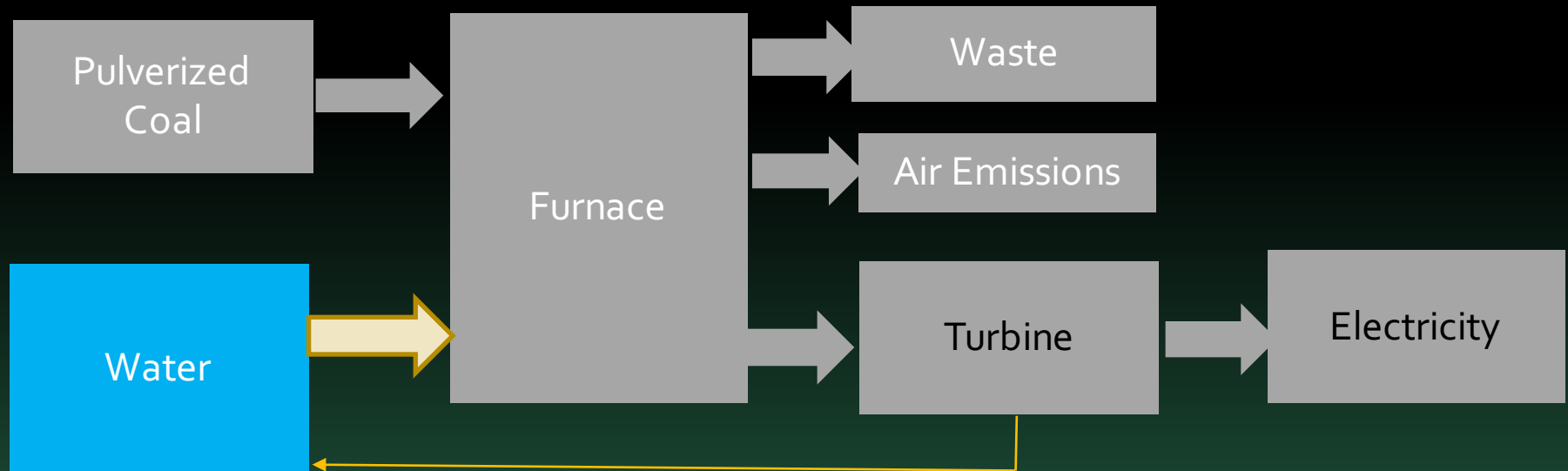


Burning Coal in the United States:

- Accounts for about $\frac{1}{4}$ of the nation's total greenhouse gas emissions every year.
- While carbon dioxide makes up a majority of greenhouse gas emissions from coal, methane and nitrous oxide also play a role.

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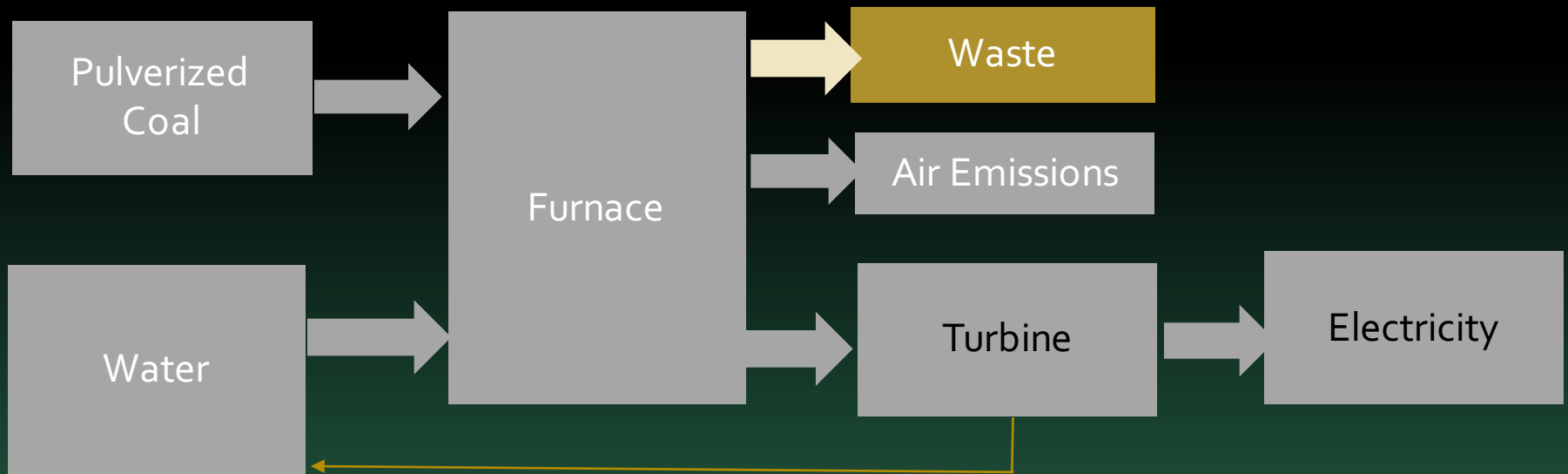


Water is fundamental to burning coal for power as it is heated into steam and used to turn the turbines that generate electricity. Water is withdrawn to support the electricity production cycle and consumed through evaporation. How much is withdrawn (overall) and how much is consumed depends on the cooling technology in a coal-based power plant.

Once-through cooling withdraws 20,000-50,000 gallons/MWh and consumes up to 300. Recirculating withdraws 500-1,200 gallons/MWh and consumes up to 1,100.

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How does it impact the environment?

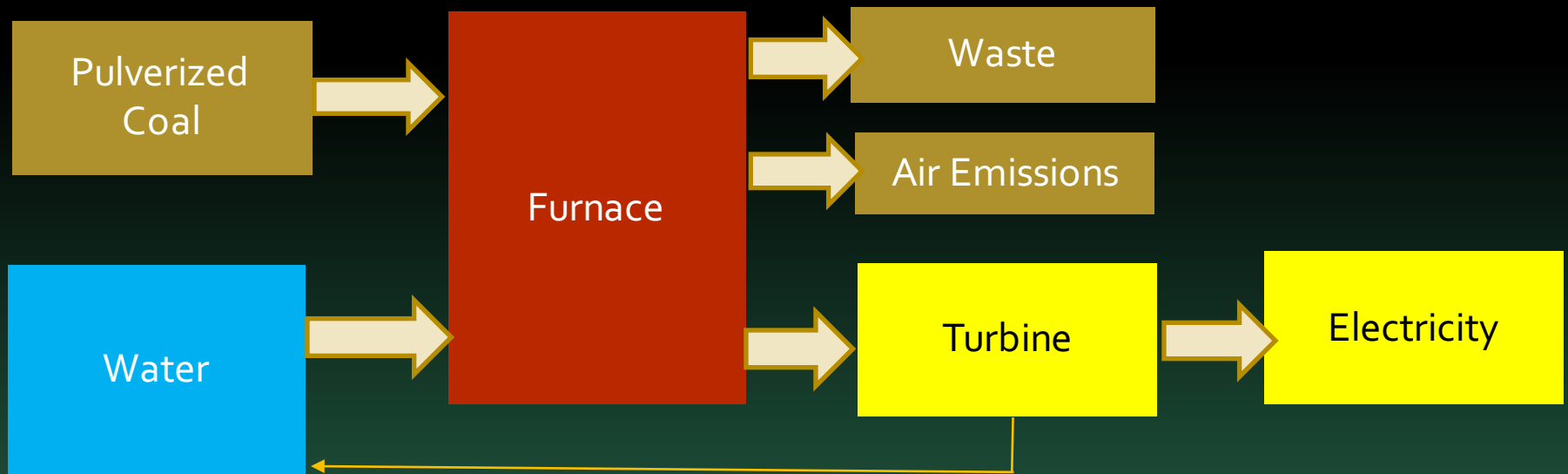


Burning coal produces solid waste, totaling over 100 million tons per year. This waste:

- Is often re-used (over 40%).
- Includes fly ash, bottom ash, boiler slag, and products of desulphurization.
- Contains toxics including arsenic, cadmium, lead, mercury, selenium, uranium, thorium, dioxins, and polycyclic aromatic hydrocarbons.
- Often ends up sitting in storage “forever” on the power plant site, making it vulnerable to leakage, leaching, and other contamination of the surrounding community.

Producing Electricity from Coal

How does it impact the environment?

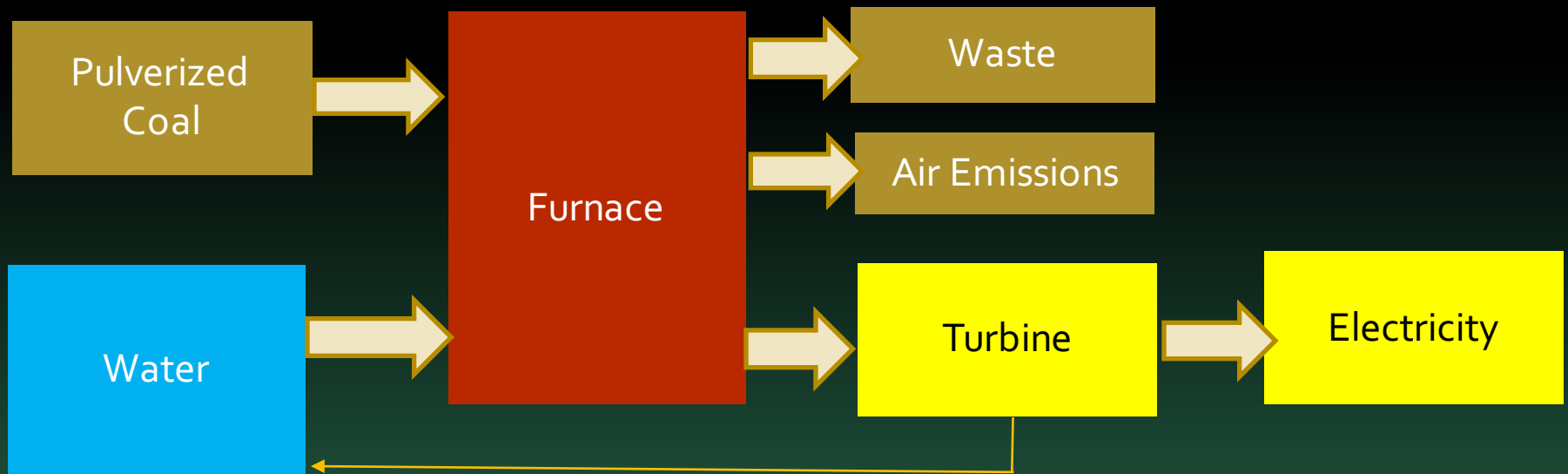


Significant environmental impacts also result from the process of mining coal.

Coal mining generates a great deal of acidic and hazardous waste which has a profound effect on water tables. Surface strip mining also destroys habitat and can permanently disrupt ecosystems.

Producing Electricity from Coal

How does it compare with other fuels?



Coal vs. the Rest (Natural Gas, Nuclear Energy, Renewables):

- Per MWh, coal burning produces about 5 times as much carbon monoxide, 400 times more particulates, and 2,000 more times sulfur dioxide than burning natural gas.
- Per MWh, coal burning produces over twice the greenhouse gases as natural gas and up to 100 times more greenhouse gases than nuclear and renewable technologies.

Producing Electricity from Coal

Why does the U.S. use so much?

Coal is ABUNDANT!

- The U.S. has about 265 billion tons that can be mined competitively.
- The U.S. mines only about 1 billion tons a year.
- That's a 265 year supply of coal at present rates of consumption.

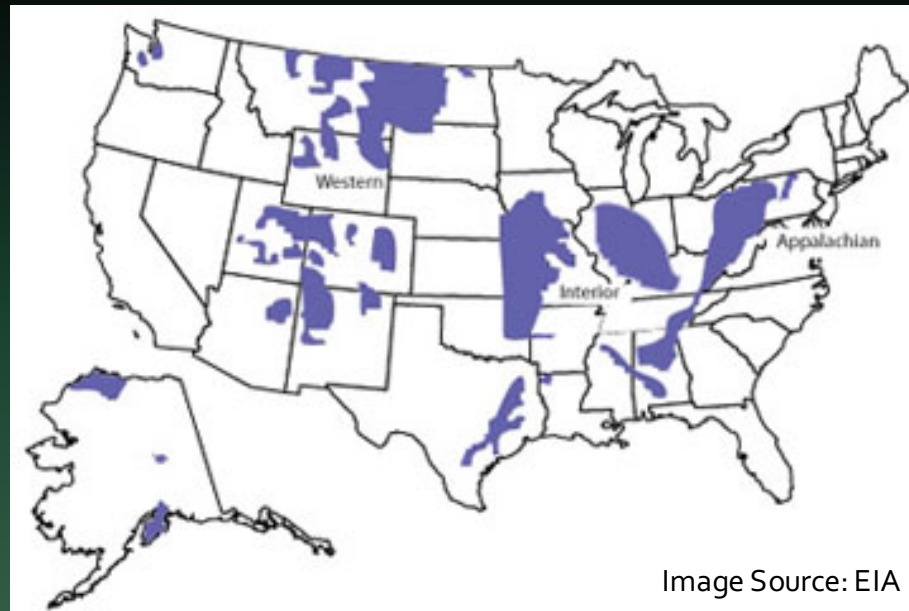


Image Source: EIA

Despite its abundance, the U.S. usage of coal continues to decline dramatically in most states, where it has been replaced by natural gas and increasing use of renewable resources.

Producing Electricity from Coal

What's next for the U.S.?

Despite the fact
that Coal is
ABUNDANT:

The use of coal continues to decline dramatically in most states, where it has been replaced by natural gas and increasing use of renewable resources.

2014: 39% of total electricity
2015: 33% of total electricity
2016: 30.9% of total electricity



Image source: Greg Goebel from Loveland CO, USA



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Additional Impacts

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

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