



Environmental Impacts of Technology

The Production of Electricity *Power from Natural Gas*



Image Source: Mscalora

Producing Electricity from Natural Gas

How does it work?

Natural Gas can be converted to Electricity using a **Gas Turbine Power Plant**

While gas turbines can power up quickly, they must be shut down for frequent repairs and are best suited for peak power rather than continuous power production.

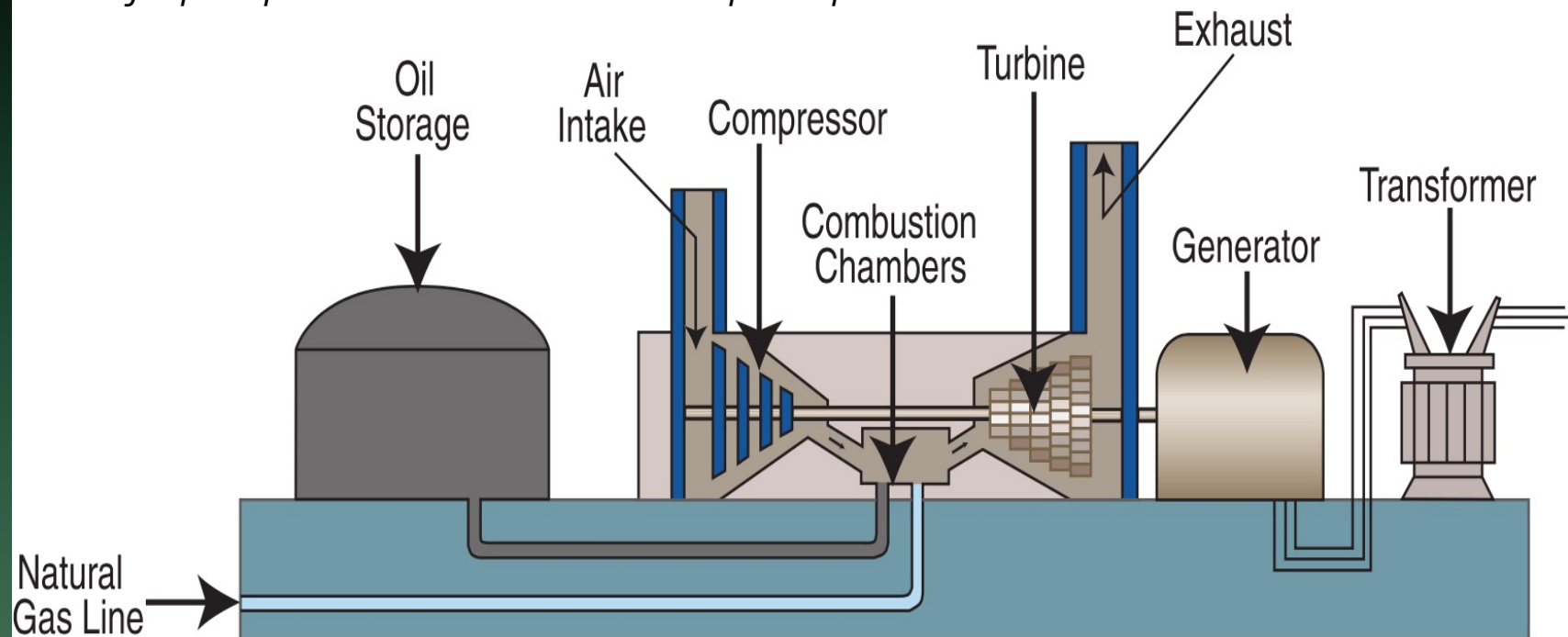
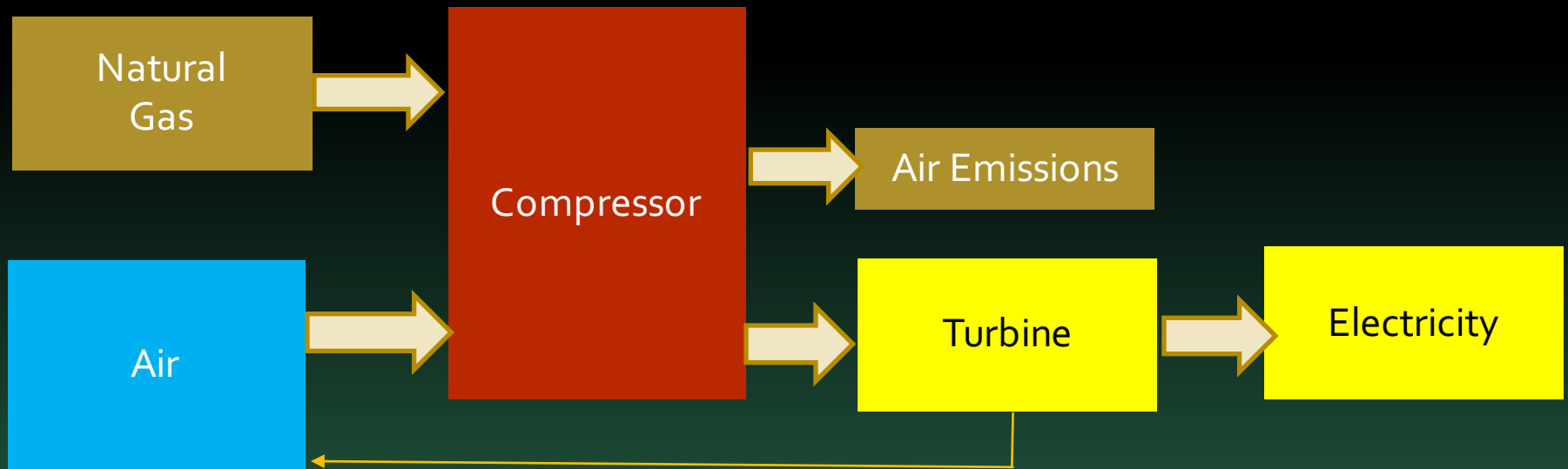


image source: Tennessee Valley Authority

Producing Electricity from Natural Gas

How does it work?



In the Gas Turbine, natural gas is converted to electricity through the Brayton cycle:

1. The compressor draws air into the plant and compresses it.
2. The compressed air is sent to the combustion chamber, where it is combined with natural gas injected via multiple fuel injectors and burned at very high temperatures.
3. The resulting high temperature, high pressure gas flows into the turbine where it turns the turbine blades to produce electricity.

Producing Electricity from Natural Gas

How does it work?

Natural Gas can also be converted to Electricity using a **Boiler Power Plant** that converts natural gas to electricity similar to the way coal is burned to produce electricity.

Boiler Power Plants last longer and require less frequent repairs, making them better suited for continuous electricity production, despite being less efficient than gas turbine power plants.

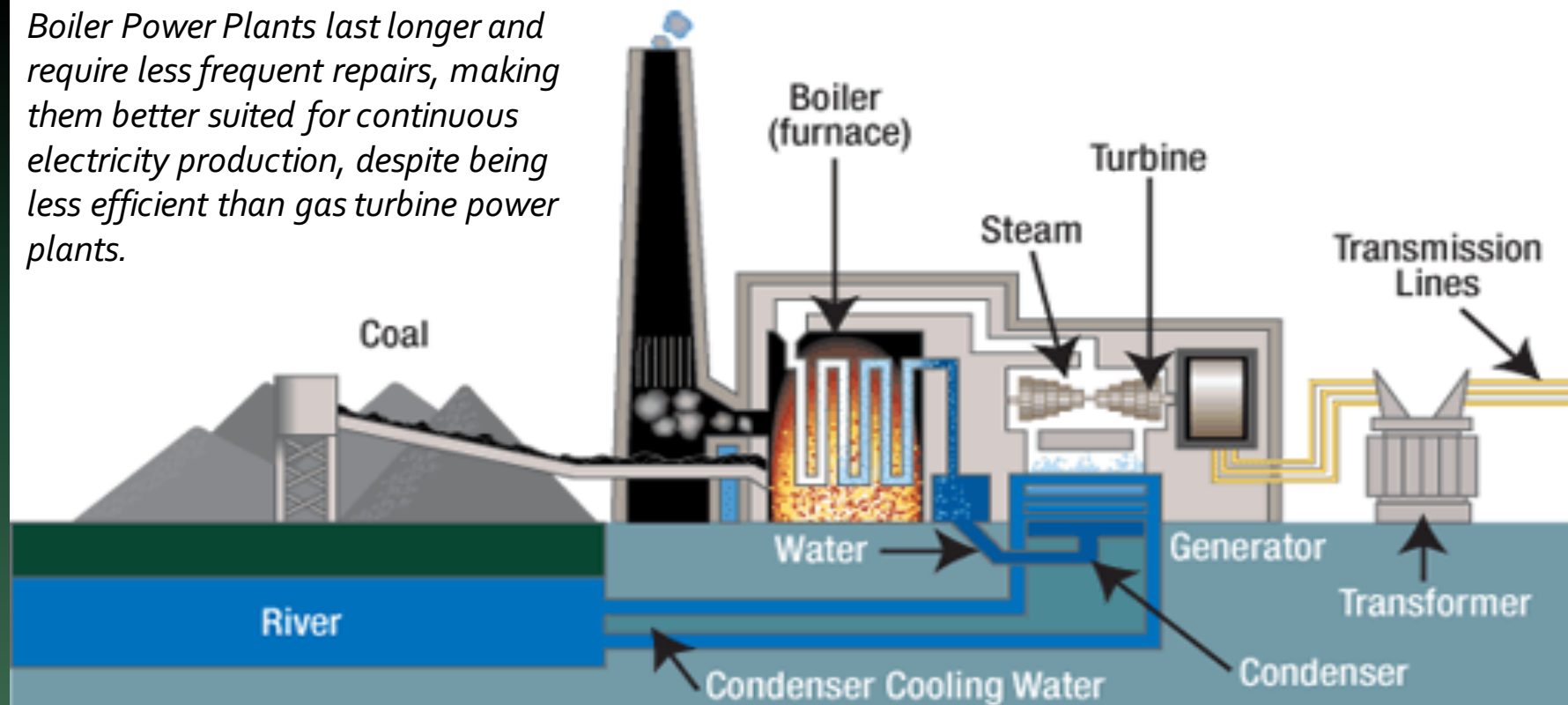
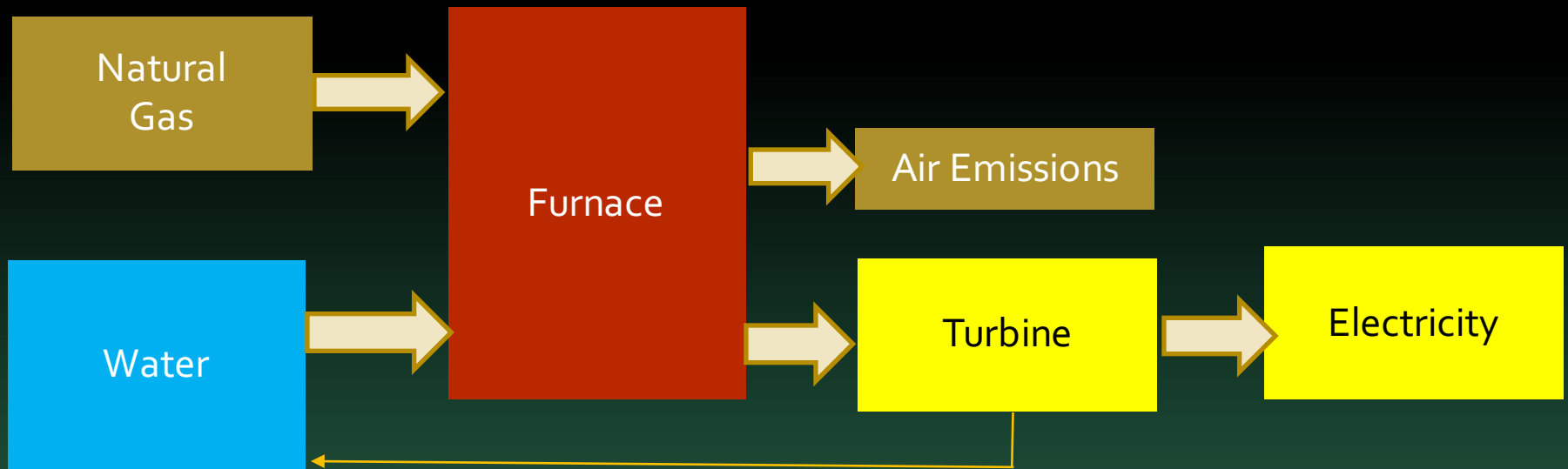


image source: Tennessee Valley Authority

Producing Electricity from Natural Gas

How does it work?



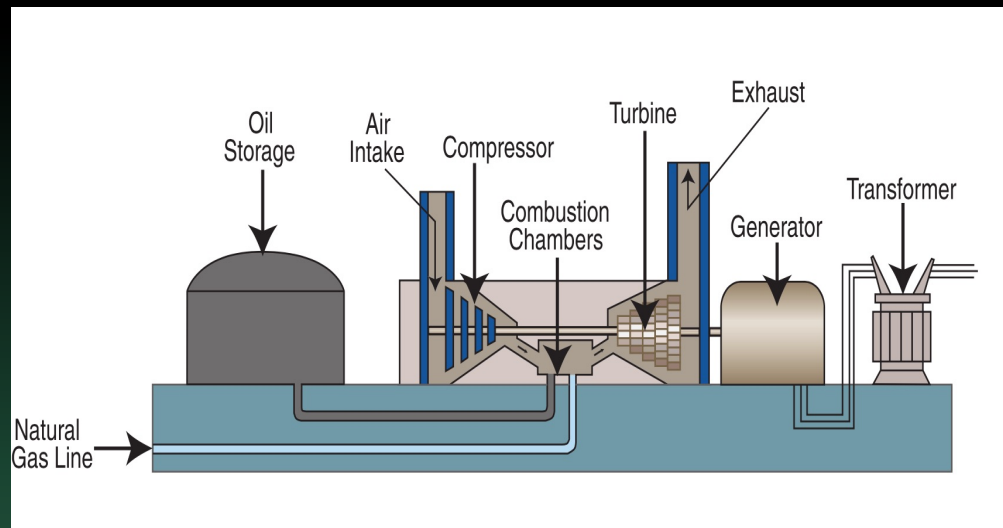
In the Boiler Power Plant, natural gas is converted to electricity through the Rankine cycle:

1. The gas 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 Natural Gas

How does it work?

Natural Gas can also be converted to Electricity using both a **Boiler Power Plant** and a **Gas Turbine Power Plant** – a **combined cycle power plant**.



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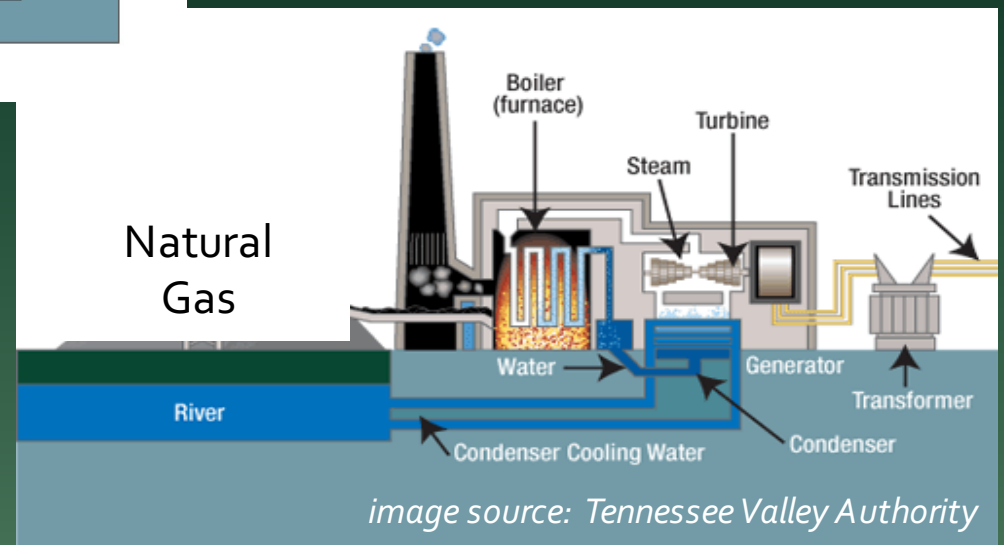
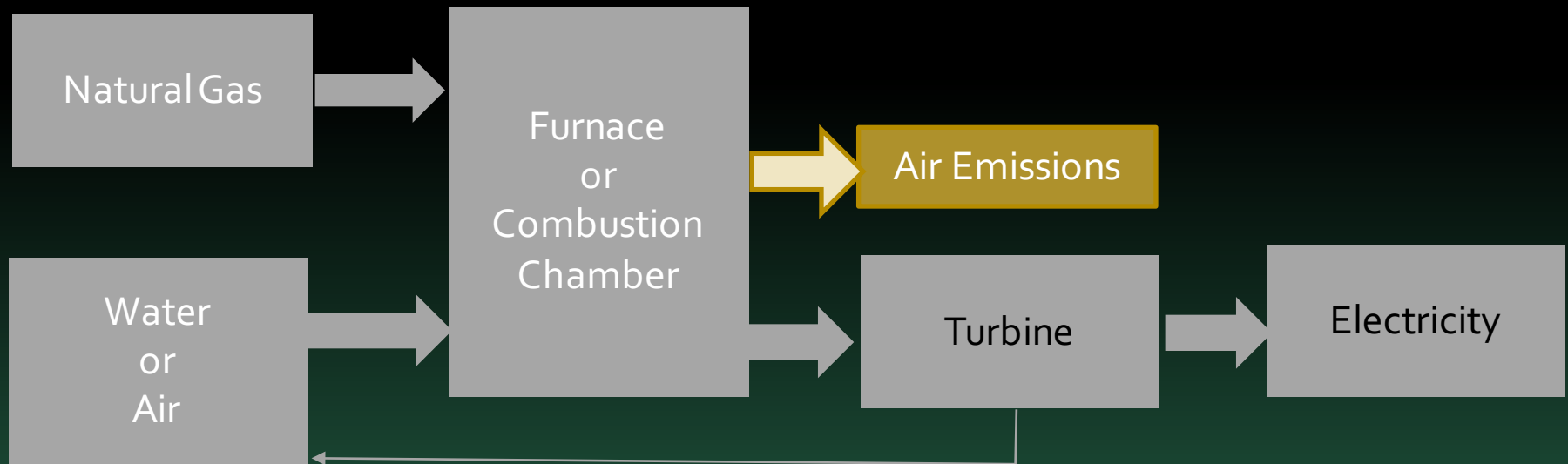


image source: Tennessee Valley Authority

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Producing Electricity from Natural Gas

How does it impact the environment?

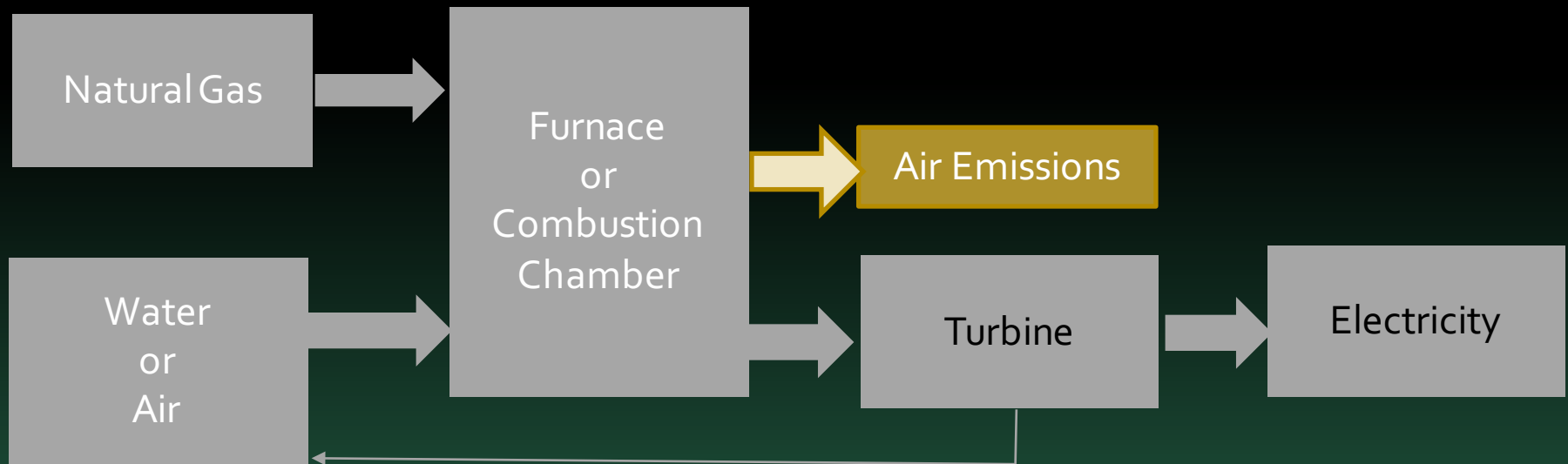


Natural Gas Power Plants produce negligible amounts of:

- Mercury
- Sulfur dioxides
- Particulates

Producing Electricity from Natural Gas

How does it impact the environment?



Burning Natural Gas in the United States:

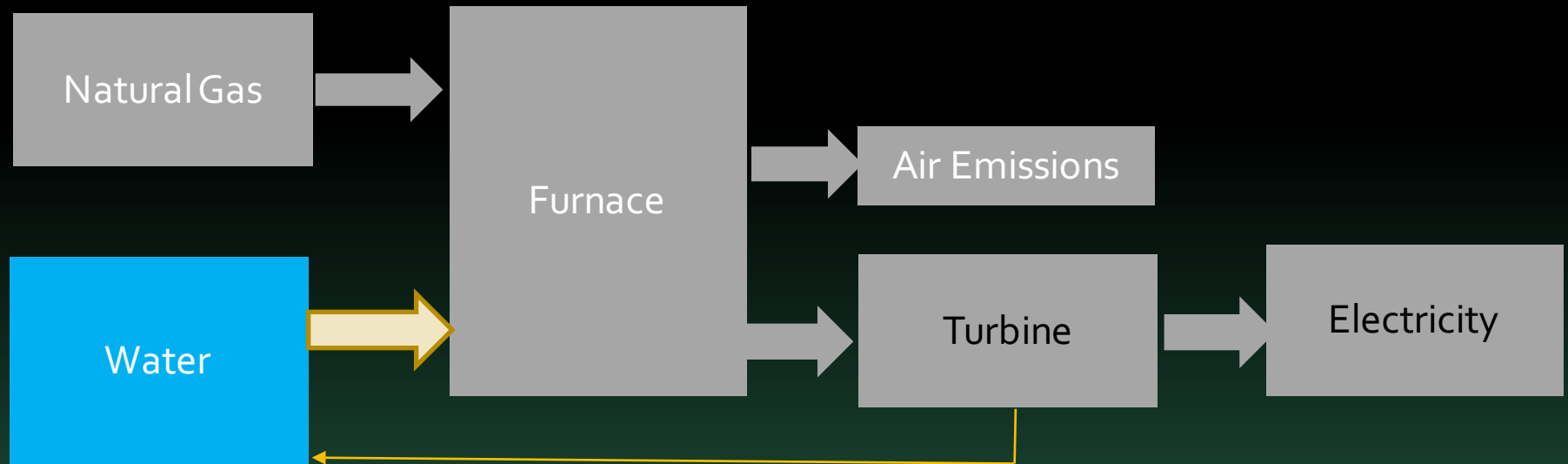
- Emits about half the amount of carbon dioxide equivalent (greenhouse) gas than coal.

But, Natural Gas

- Leaks during production, emitting significant methane, a potent greenhouse gas.
- Can emit significant amounts of ozone and particulates during extraction (e.g. drilling).

Producing Electricity from Natural Gas

How does it impact the environment?



Water is fundamental to burning natural gas for power in a boiler style power plant 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.

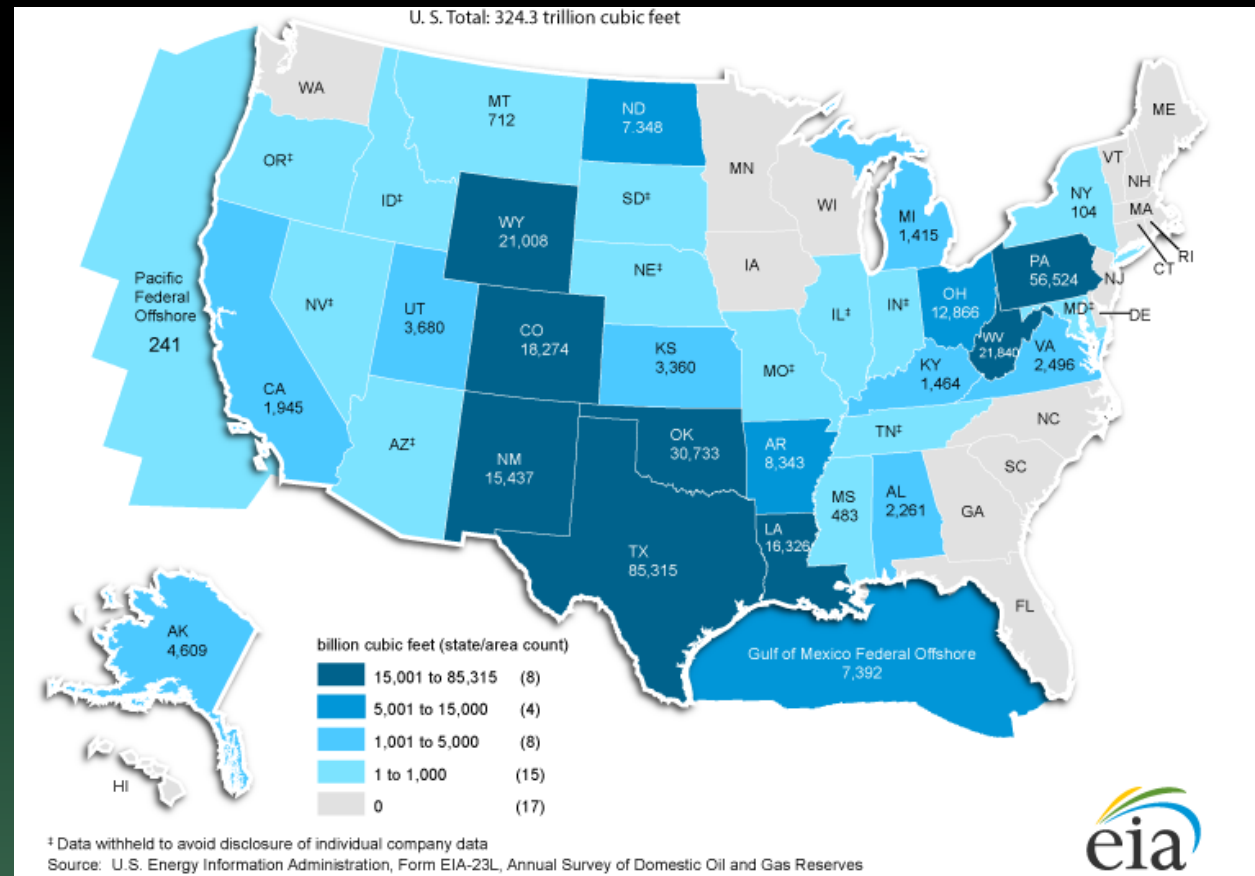
However, natural gas power plants still use less water than coal-based plants (and nuclear power plants). At the present time, natural gas power plants, on average, use a quarter (25%) of the water used by coal-burning plants. However, some methods used to extract natural gas from the earth, like fracking, can involve huge amounts of water withdrawal and usage.

Producing Electricity from Natural Gas

Why does the U.S. use so much?

Natural Gas is ABUNDANT!

- The U.S. has up to 250 years left of natural gas reserves.
- Among fossil fuels, burning natural gas is clean—it produces fewer greenhouse gases and toxic emissions than coal.



Natural gas use for electricity has increased dramatically over the past decade, in large part due to much reduced emissions and air quality impact compared to coal.

Producing Electricity from Natural Gas

What's next for the U.S.?

Because Natural Gas is **ABUNDANT** and **CLEAN** compared to coal:

The use of natural gas will continue to increase in the United States until renewable (or nuclear) energy and resources can take its place as a leader in meeting electricity demand.

2014: 28% of total electricity
2015: 32% of total electricity
2016: 34% of total electricity



Image Source: Mscallora





Environmental Impacts of Technology

Additional Impacts

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

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