



## Electrification: 101

### What is Electrification?

Electrification is a process that involves converting fossil-fuel energy sources to electricity. This method can be applied to a wide range of systems, whether big or small, and can power anything from industrial machinery to household appliances.

The growing importance of reducing carbon emissions and mitigating the impacts of climate change has led to a push for electrification in recent years. While the process is not without challenges, widespread electrification could greatly reduce greenhouse gas (GHG) emissions.

### Why Electrify?

Primarily, electrifying systems is one of the many concepts employed to support larger decarbonization efforts to reduce fossil fuel usage and greenhouse gas emissions. With respect to decarbonization, electrification can be used to achieve several goals:

1. By converting appliances or systems that use fossil fuels to electric power, the use of fossil fuels and their associated emissions are **removed** from the end process.
2. Electric-powered systems are often more efficient than their fossil fuel counterparts, thus leading to a reduction in both energy use and greenhouse gas emissions from electrical generation.
3. Electrification also consolidates emissions profiles. In lieu of considering emissions from fossil fuel use at the end use, the focus can move purely to emissions associated with electrical generation.

### Areas of Opportunity

Analysis of EPA data for 2020 reveals that five sectors, namely transportation, electric power generation, commercial and residential properties, agriculture, and industry contributed significantly to greenhouse gas emissions. Although the process of electrification can help reduce emissions in all these areas, the transportation and buildings sectors have the most significant potential for immediate deployment.

### Electrical Generation

Electrification alone is not an effective solution if electricity is produced in unsustainable ways. When coupled with clean electrical generation, i.e. using renewable energy sources, electrification can be a power tool for decarbonization.

Though fossil fuels top the American energy mix, not all fossil fuels are the same. Natural gas, which has risen as a fuel in the domestic energy mix in the last decade, is 60 percent less emissive than coal, the previously dominant fuel in the United States.

#### United States Energy Mix - 2022 [1]

**Natural Gas - 39.8%**

**Coal - 19.5%**

**Nuclear - 18.2%**

**Wind - 10.2%**

**Hydropower - 6.2%**

**Solar - 3.4%**

**Biomass - 1.3%**

Renewable energy poses a great opportunity for decarbonizing electricity generation. Generating electricity through renewable sources produces little to no emissions, making their development a key piece of the electrification equation.

### The Grid

As electrification is adopted, demand for electricity will follow suit. This reality brings the importance of the electric grid system into focus. Improvements and modernization of the existing grid, along with the development of new electrical transmission, distribution, and storage infrastructure are necessary for such a transition.

Renewable sources such as solar and wind power have an advantage over traditional power plants – they can be generated anywhere with a fuel source. Due to this, they are considered "distributed" as they do not require a centralized location for generation. However, to be utilized or stored, these distributed sources need to feed back into the grid. As their share of the domestic energy mix continues to grow, our grid systems will need to be able to handle the surge of energy produced by these non-traditional sources.



## Electrification: 101

### Transportation

According to EPA data, the transportation sector was responsible for 27 percent of US greenhouse gas emissions in 2020.

The recent rise in electric vehicles is a prime example of electrification in action. While all modern vehicles use electricity for vehicle functions, fully electric vehicles with no internal combustion engines generate no emissions at the tailpipe. However, emissions from generating the electricity used to fuel the vehicle are still a concern. The rise in popularity and purchases of electric vehicles (EVs), and federal policies like the Inflation Reduction Act, which incentivize the purchase of EVs is a result of the push for decarbonization by electrification.

The potential for electric vehicles extends beyond passenger cars to commercial vehicles, including heavy-duty trucks and semis. However, there are several obstacles that need to be addressed, such as limited national charging infrastructure, technical limitations, and cost-effectiveness.

Public transportation presents an opportunity for electrification as well, through the electrification of busses, trains, and other forms of public transportation.

### Buildings & Homes

Buildings and homes were responsible for 13 percent of US greenhouse gas emissions in 2020, according to EPA data. Buildings present several opportunities for electrification that are currently deployable. Buildings typically have several systems that either directly or indirectly use fossil fuels and can be electrified. Two key examples lie with the heating and cooling systems and in cooking systems.

Heat pumps, electric furnaces, and stoves are other existing technologies that can be easily adapted to electrify buildings. However, it may not be feasible for many existing structures due to financial or other factors. Policymakers can address this by updating building codes to require only electric appliances and systems for new construction, presenting an opportunity for a more sustainable future.

### Federal Policies for Electrification

There are various federal initiatives and programs that encourage different areas of electrification. Two significant pieces of legislation that drive electrification efforts are the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA).

The BIL and IRA feature several initiatives related to electrifying our economy, including [2] [3]:

- \$66B in funding for zero-emission public transit, including busses and trains
- \$7.5B to create a national network of EV charging stations
- \$5B for the adoption of low-and-zero-emission school busses
- \$42B to modernize our seaports and airports to accommodate greater electrification and address capacity constraints
- \$65B to upgrade and modernize our electrical power infrastructure to ensure its ability to keep up with increased demands and varied sources of electricity
- Various rebates and tax credits for consumers who purchase electric-powered products

### Pennsylvania State Policies for Electrification

Pennsylvania offers several programs and initiatives designed to further electrify the state, including [4]:

- Alternative Fuel Vehicle Rebate
- EV Charging Station Rebate
- Tax credits for the purchase of hydrogen energy
- Various grants for EV and alternative fuel vehicle procurement and fleet transformation

## **Electrification: 101**

### **Works Cited**

[1] Environmental Protection Agency. (n.d.). Sources of Greenhouse Gas Emissions. EPA. Retrieved February 6, 2023, from <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>

[2] The United States Government. (2022, August 17). State fact sheets: How the inflation reduction act lowers energy costs, creates jobs, and tackles climate change across America. The White House. Retrieved April 4, 2023, from <https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/17/state-fact-sheets-how-the-inflation-reduction-act-lowers-energy-costs-create-jobs-and-tackles-climate-change-across-america/>

[3] The United States Government. (2023, March 29). Fact sheet: The Bipartisan Infrastructure Deal. The White House. Retrieved April 4, 2023, from <https://www.whitehouse.gov/briefing-room/statements-releases/2021/11/06/fact-sheet-the-bipartisan-infrastructure-deal/>

[4] United States Department of Energy. (n.d.). Pennsylvania laws and Incentives. Alternative Fuels Data Center: Pennsylvania Laws and Incentives. Retrieved April 4, 2023, from <https://afdc.energy.gov/laws/all?state=PA>