



A Qualitative Comparison: Carbon Dioxide Emissions From Residential Space & Water Heating Using Propane vs. Electricity





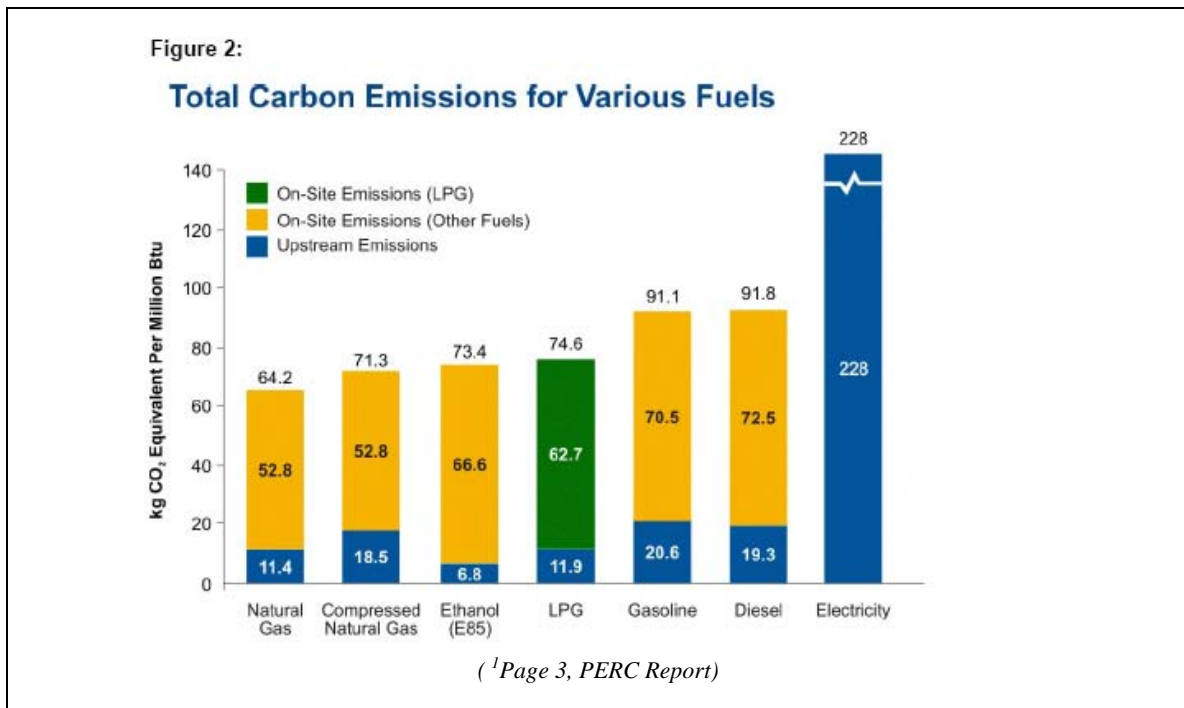
I. Overview

The primary purpose of this comparison is to highlight the reduction in Carbon Dioxide emissions when using propane in lieu of electricity for residential space heating and water heating.

II. Upstream vs. Onsite Emissions

The term ‘upstream emissions’ refers to the amount of carbon dioxide emissions generated by processes leading up to the use of a given fuel. For example, this could include CO₂ emissions from mining operations, fuel source transport, processing in a refining plant, or consumption in an electric power generating plant. Onsite emissions are emissions that are generated at the point of user-consumption; this includes, for example, the CO₂ that is generated when propane fuel is ignited to generate heat underneath a the tank of a household water heater.

The following graph is useful to compare the total CO₂ emissions for electricity vs propane.



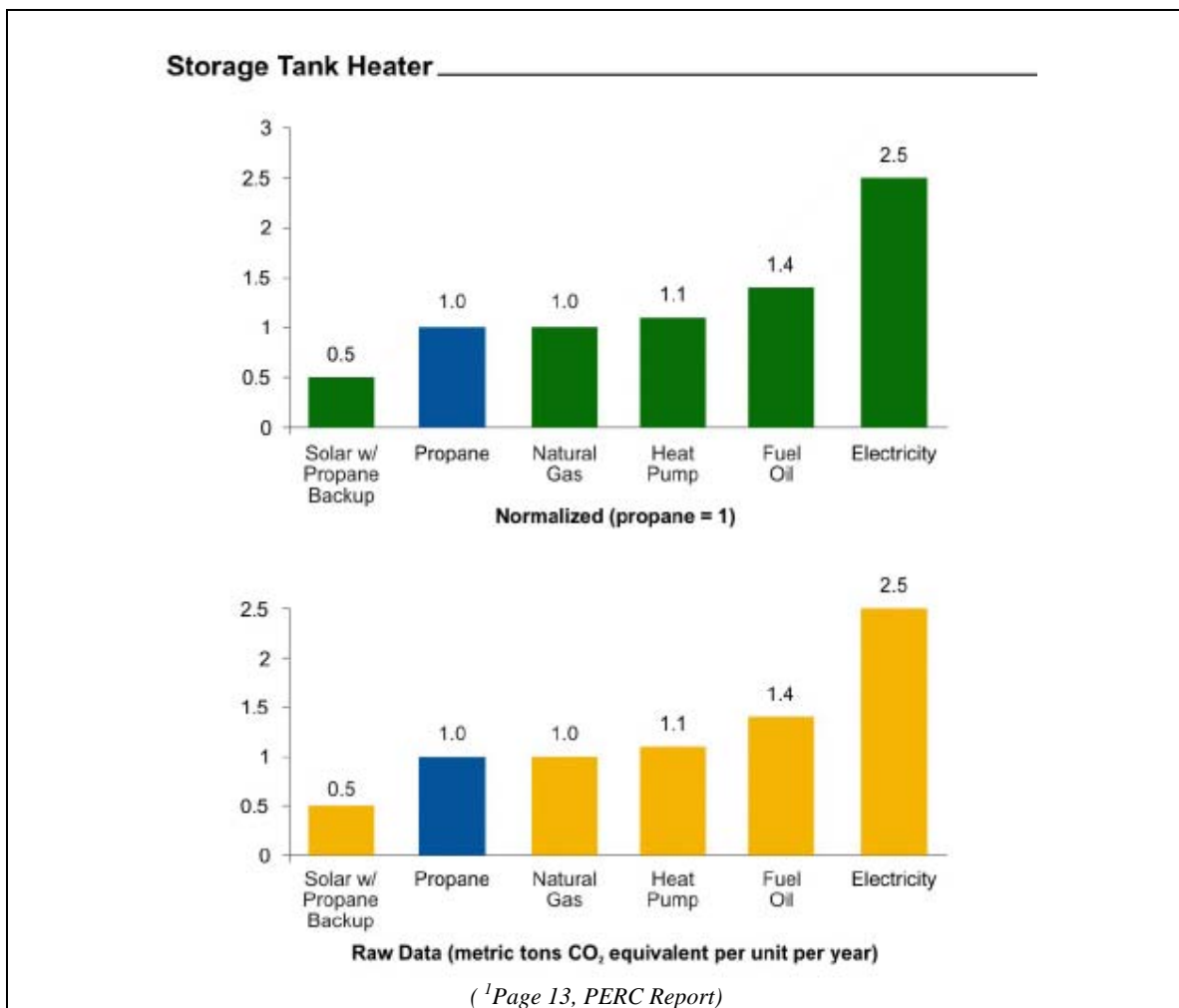
Note that electricity’s emissions are 100% upstream, while propane is a combination of upstream and on-site. This is because once electricity has been generated at the power



plant, it simply travels through transmission wires; hence all carbon emissions related to electricity generation are upstream. Propane, on the other hand, is produced as a byproduct at refining plants for oil and natural gas. When it is consumed by an appliance, like a stovetop, the combustion of the fuel releases a small amount of CO₂. Thus, propane's CO₂ emissions are a combination of upstream and onsite.

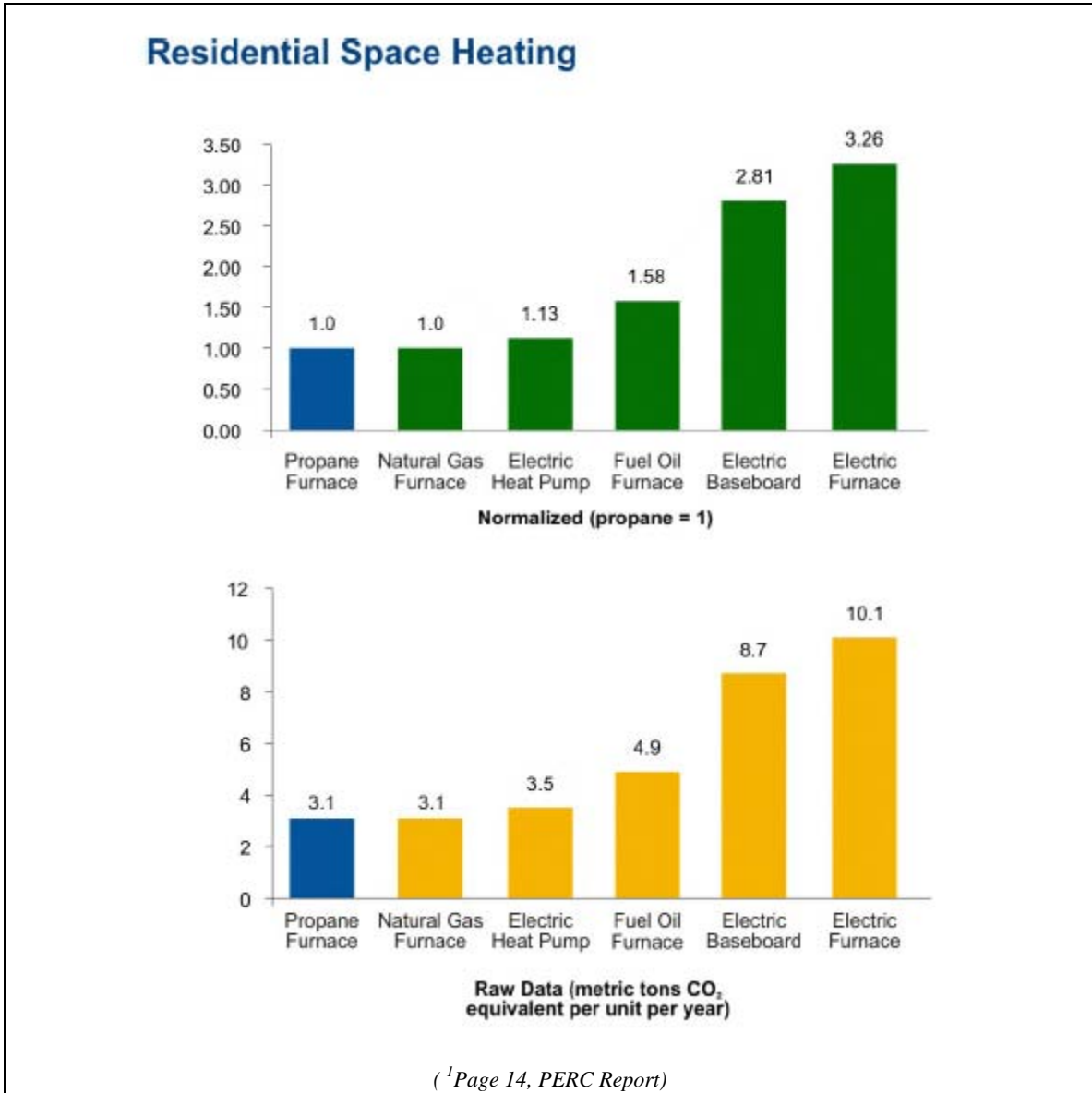
III. Emissions Ratios

Studying the chart below, it becomes clear that **using an electric water heater emits 2.5 times the CO₂ released by a propane water heater** (for the time being we are not considering tankless heaters, although the difference is nearly identical and figures can be found in the same report referenced herein).





And for space heating, the difference is greater: **an electric furnace releases 3.26 times the CO₂ released by using propane for space heating.**





IV. Calculations

- We need to determine the total annual CO₂ emissions emitted by the average electric storage tank water heater, and the average electric furnace. Then we can use our emissions ratios (2.5 for the water heater, 3.26 for the space heater) to determine the difference in CO₂ emissions for each, and finally tally a figure for the difference between using electricity and using propane for space and water heating.
 - The average figures for electricity usage for residential space and water heating are as follow²:
 1. The average home using electricity for home heating consumes for this purpose, annually, approximately 3,517 kwh of electricity.
 2. The average home using electricity for water heating consumes for this purpose, annually, approximately 2,550 kwh of electricity.
- On average, power plants must generate 3.3 kwh of electricity for every 1 kwh that can be consumed in a home². This efficiency degradation is due to the loss associated with transmission lines carrying the electricity from the plant to the home. Using this figure, we determine the total amount of electricity that must be generated in order to deliver our consumable electricity into the home:
 1. 3,517 kwh of electricity in the home requires 11,606 kwh to be generated at the plant.
 2. 2,550 kwh of electricity in the home requires 8,415 kwh to be generated at the plant.
- The U.S. average pounds of CO₂ produced per kwh of electricity generated is 1.34 pounds³.
 1. 3,517 kwh of electricity for space heating generates $11,606 \times 1.34 = 15,552$ pounds of CO₂ or 7.776 tons (here we're using short tons, where 1 ton = 2000 pounds).
 2. 2,550 kwh of electricity for water heating generates $8,415 \times 1.34 = 11,276$ pounds of CO₂ or 5.638 tons.



Now we have:

Electric Space Heating → 7.776 tons of CO₂

Electric Water Heating → 5.638 tons of CO₂

These total $7.776 + 5.638 = \mathbf{13.414 \text{ tons of CO}_2}$

And we know

Electric Space Heating emits 2.5 times the CO₂ of propane space heating.

Electric Water Heating emits 3.26 times the CO₂ of propane water heating.

So we have:

Propane Space Heating → $7.776/2.5 = 3.110$ tons of CO₂

Propane Water Heating → $5.638/3.26 = 1.729$ tons of CO₂

These total $3.110 + 1.729 = \mathbf{4.839 \text{ tons of CO}_2}$.

Total (Elec) – Total (Propane) = 13.414 – 4.839 = 8.575.

IV. Conclusions

One home using propane for space and water heating annually generates 8.575 tons of CO₂ **LESS THAN** using electricity for space and water heating.

Note that the average vehicle emits 5.5 metric tons or 6.063 short tons of per year⁴.

Annually, a single home using propane instead of electricity for space and water heating effectively offsets 8.575 tons of carbon emissions. This is more than the annual carbon emissions from an average vehicle.



SOURCES:

¹ *'Propane Reduces Greenhouse Gas Emissions: A Comparative Analysis'*, June 2007, Produced by Energetics, Sponsored by the Propane Education & Research Council

² Average figures for electricity usage come from the June, 2007 issue of Popular Mechanics magazine, article titled "Know Your Footprint: Energy" (much of the information can be accessed online at <http://www.popularmechanics.com/footprint>).

³ Department of Energy statistic, can be found:
<http://www.eia.doe.gov/oiaf/1605/ee-factors.html>

⁴ Department of Energy statistic, can be found:
<http://www.epa.gov/otaq/climate/420f05004.htm>