

Liquefied Petroleum Gas (LPG) Pricing and its Link to Demand, Air Pollution and Deforestation in Colombia

E. Adrian Calcano, Brendan Doner
Harvard Extension School
August 22, 2024



Agenda

1. Introduction
2. Energy Ladder
3. Questions
4. LPG Demand
5. Air Pollution
6. Deforestation
7. Conclusion



Introduction

Brendan Doner

From Colorado in the U.S.A. also lived and worked in Argentina and Brazil and lived in Uruguay

Professional

Principal Data Scientist at Pilot (largest truck stop operator in North America)

Owner & Operator of Breathe Transport (hydrogen production & car rental)

Education

Bachelors in Computer Information Systems from Colorado State University

M.B.A. from the University of Colorado Denver

M.S. in International Business from the University of Colorado Denver

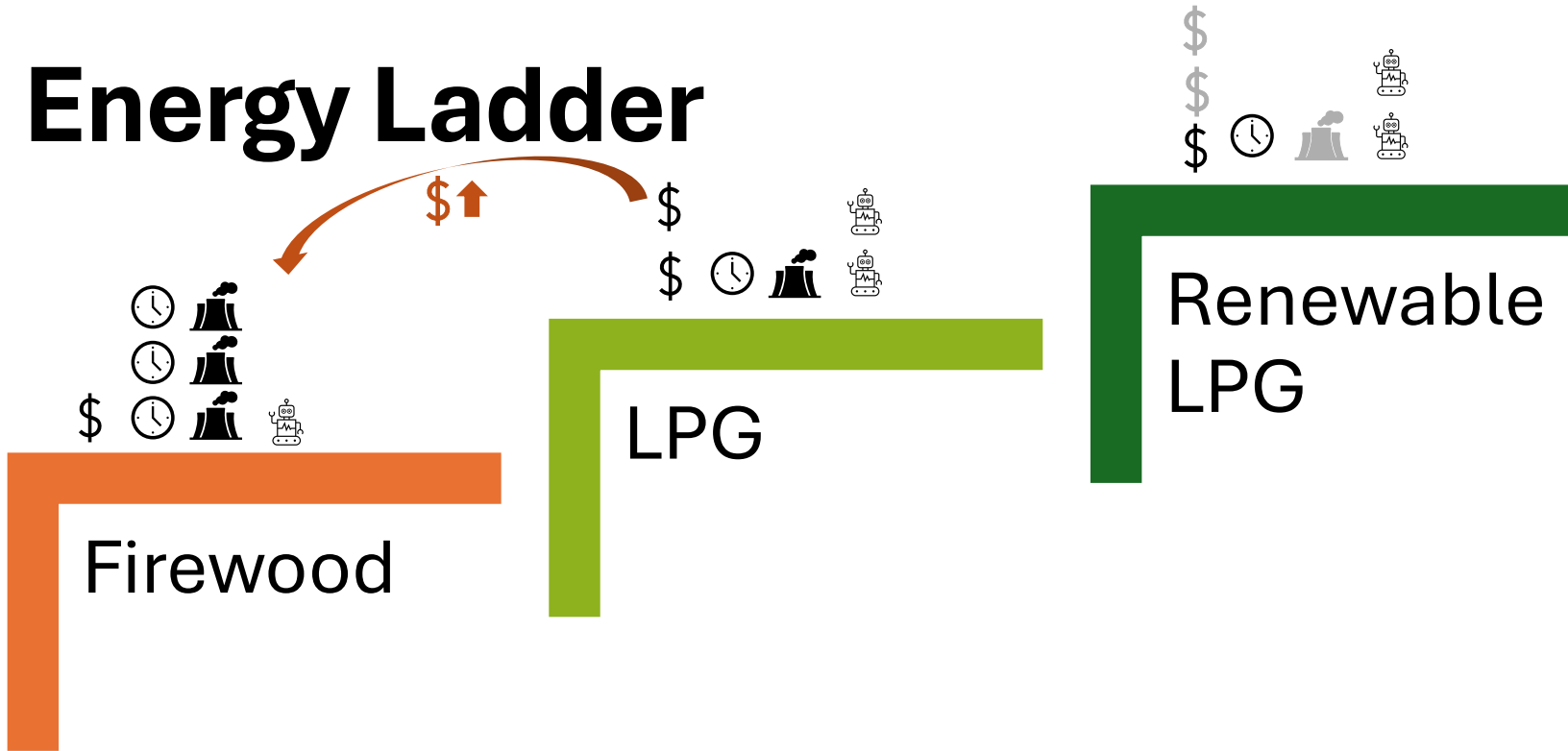
M.A. in Data Science from the Harvard Extension School

Agenda

1. **Introduction**
2. Energy Ladder
3. Questions
4. LPG Demand
5. Air Pollution
6. Deforestation
7. Conclusion



The Energy Ladder



Agenda

1. Introduction
2. Energy Ladder
3. Questions
4. LPG Demand
5. Air Pollution
6. Deforestation
7. Conclusion

\$ Cost

🕒 Inconvenience

🏭 Pollution

🤖 Technology

LPG vs Firewood for Cooking

- **Less time for cooking preparation** due to LPG stoves fast lighting
- **Fewer refueling trips** due to its higher energy density
- **Less storage space** due to its high energy density
- **Air is cleaner around the home (air pollution)** due to its higher burning efficiency
- **LPG helps forests (deforestation)** by keeping the trees and wood in the forest

However, LPG costs more and it requires more technology for cooking. LPG must also compete with flavor preferences for cooking with wood and human's attraction to the smell of wood smoke.¹

We will examine the relationship between LPG pricing and demand and will see if there is satellite-data evidence that support LPG's benefits of reduced air pollution and deforestation.

¹ The Heartbeat of Trees: Embracing Our Ancient Bond with Forests and Nature by Peter Wohlleben, 2021.

Questions

- **Do higher LPG prices** lower demand?
 - Assumption that lower LPG demand equals increased firewood use.
- **Does air pollution increase** when LPG demand decreases?
- **Does deforestation increase** when LPG demand decreases?

Agenda

1. Introduction
2. Energy Ladder
3. **Questions**
4. LPG Demand
5. Air Pollution
6. Deforestation
7. Conclusion

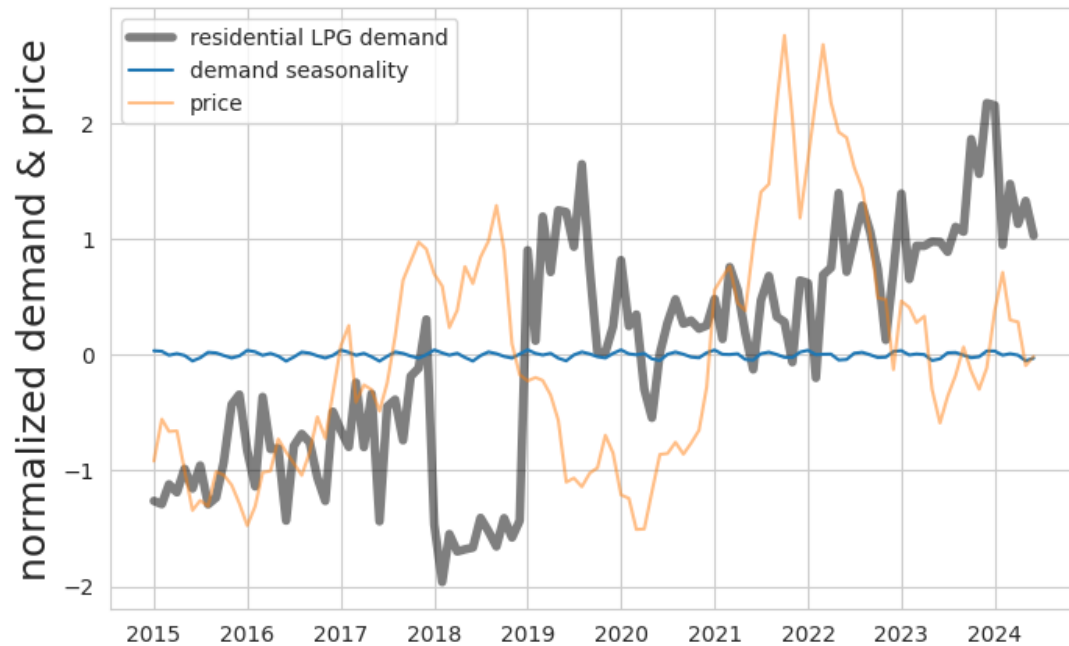


LPG Demand

Agenda

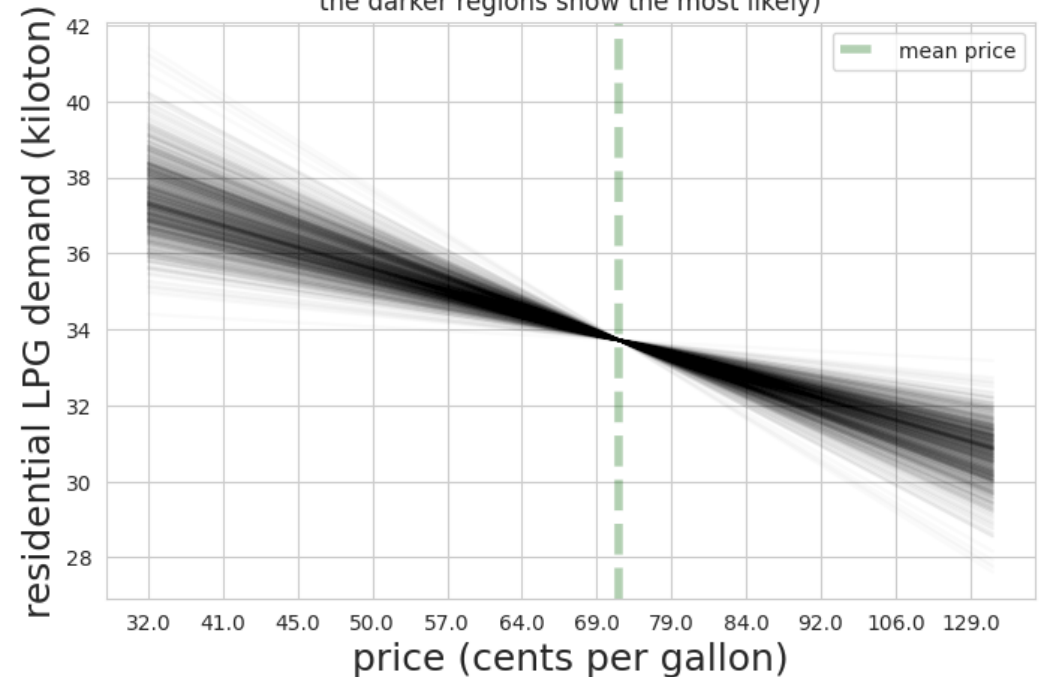
1. Introduction
2. Energy Ladder
3. Questions
4. **LPG Demand**
5. Air Pollution
6. Deforestation
7. Conclusion

LPG Demand & Price



LPG Demand & Price Relationship

(showing multiple possibilities for demand curves, the darker regions show the most likely)



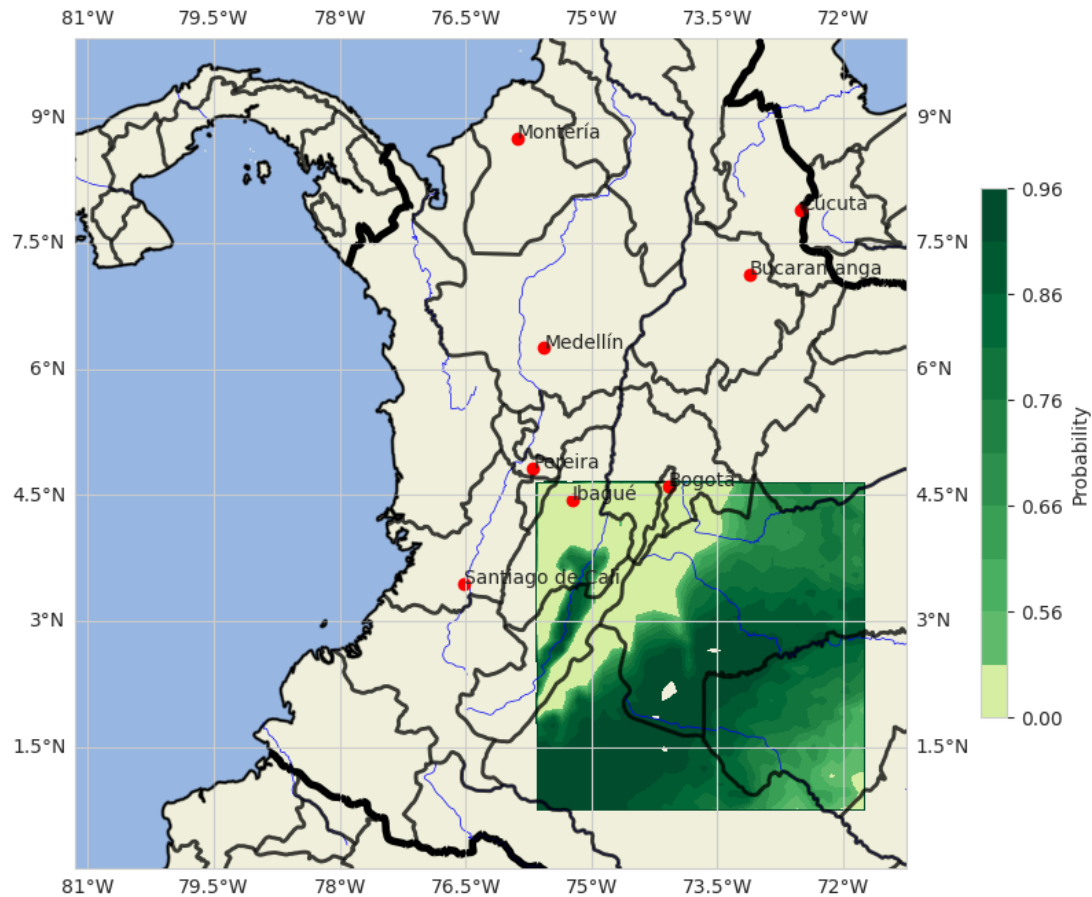
Data Time Period: Jan 2015 to Jun 2024

Price Source: LPG Mt Belvieu Enterprise month 1, Houston close, midpoint, USC/USG, pipeline fob, cents per gallon

Demand Source: Oil Price Information Service, LLC

Air Pollution

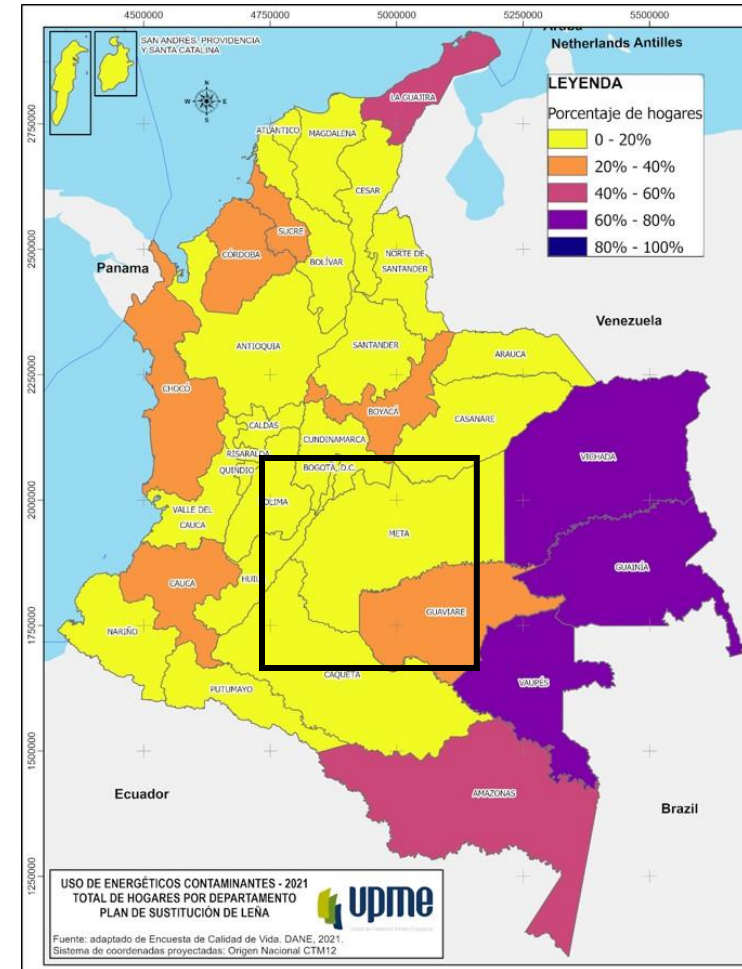
When LPG ↓ Does Air Pollution ↑



Data Time Period: May 2015 to Dec 2022

Air Pollution Source: PM2.5, Atmospheric Composition Analysis Group, Washington University in St. Louis. MODIS, VIIRS, MISR, SeaWiFS, and VIIRS satellite missions.

Percentage Using Inefficient Fuels for Cooking

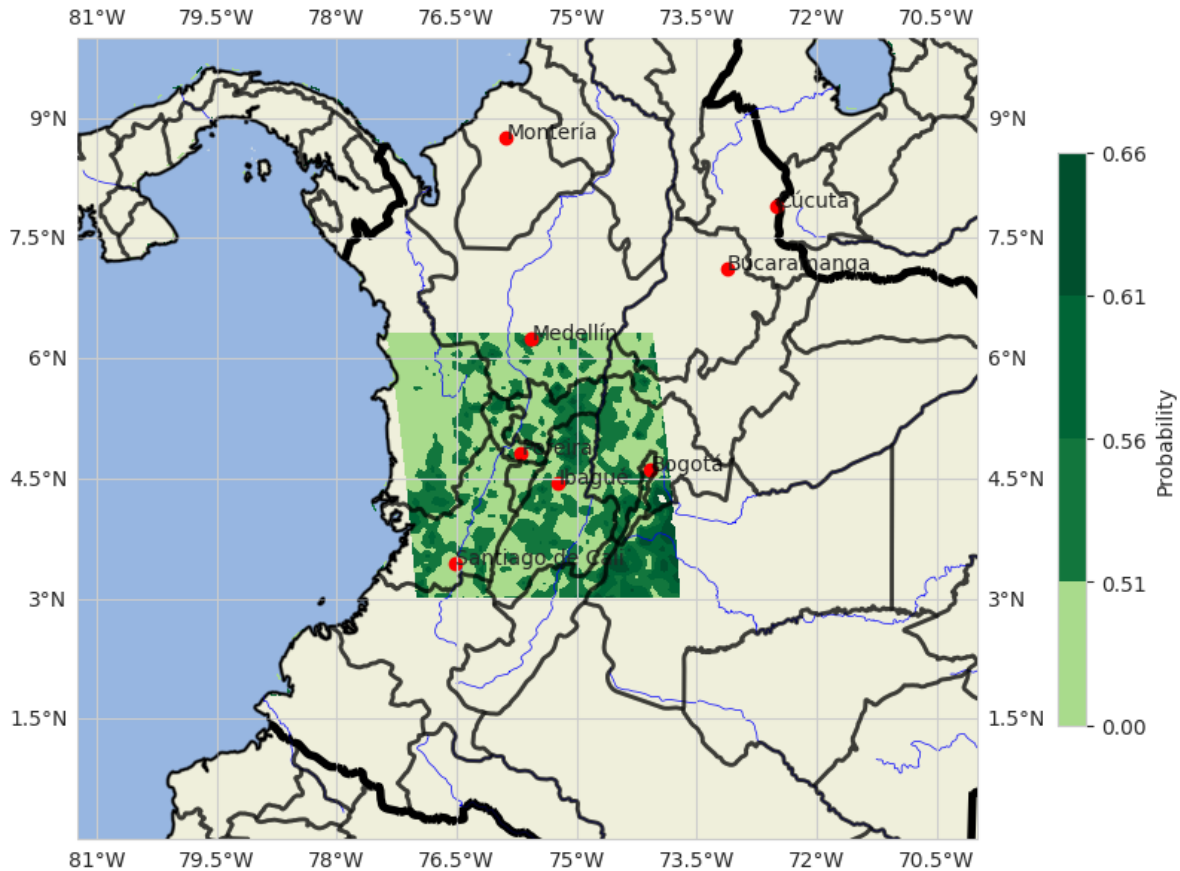


Agenda

1. Introduction
2. Energy Ladder
3. Questions
4. LPG Demand
5. **Air Pollution**
6. Deforestation
7. Conclusion

Deforestation

When LPG ↓ Does Deforestation ↑

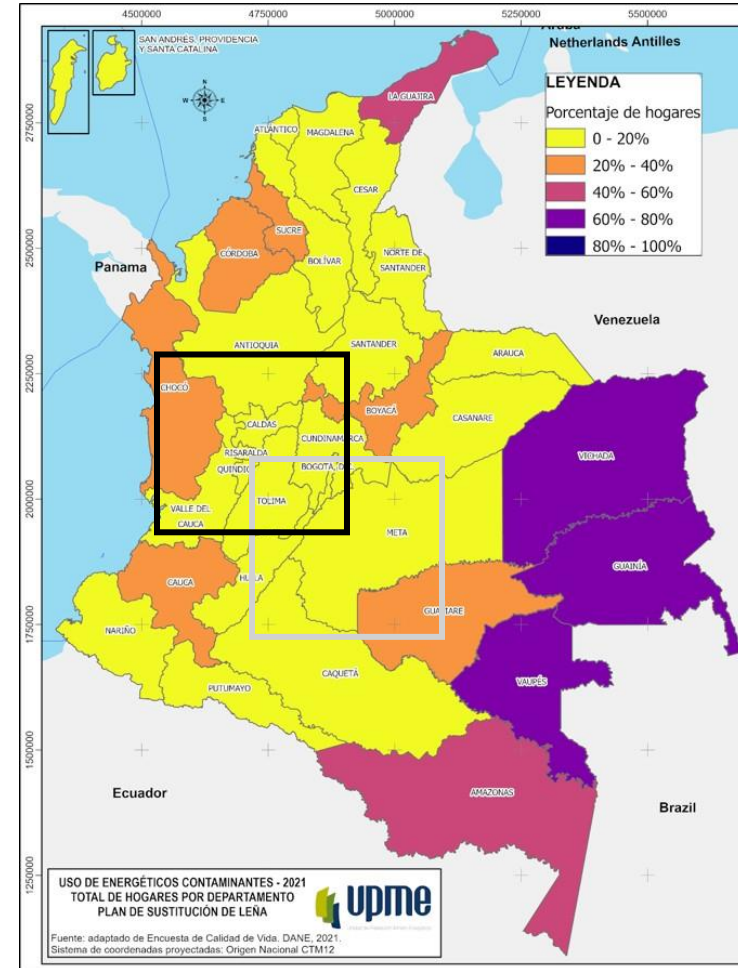


Data Time Period: May 2015 to May 2024

Deforestation Source: Normalized Density Vegetation Index (NDVI)

MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V061

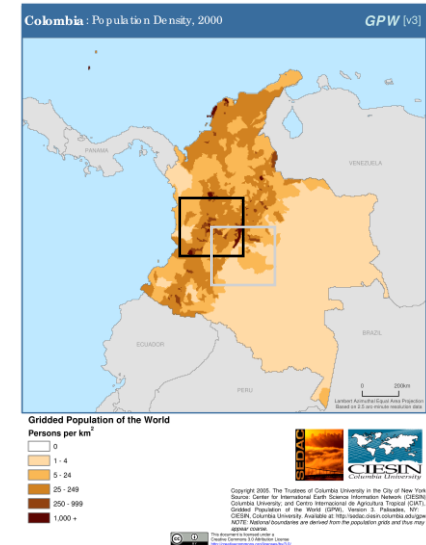
Percentage Using Inefficient Fuels for Cooking



Agenda

1. Introduction
2. Energy Ladder
3. Questions
4. LPG Demand
5. Air Pollution
6. **Deforestation**
7. Conclusion

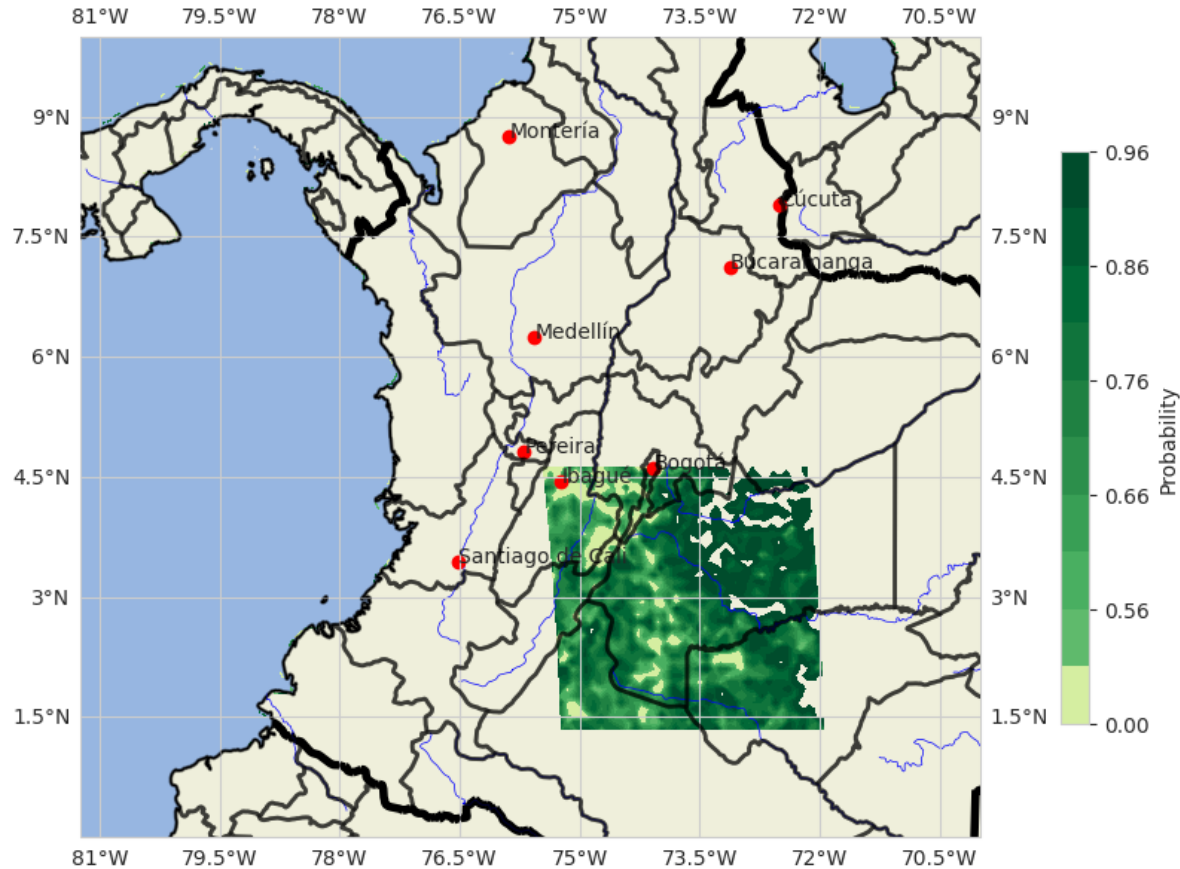
Population



Copyright 2005, The Trustees of Columbia University in the City of New York. Source: Center for International Earth Science Information Network (CIESIN), Columbia University; and Center for International Agriculture Research (CIAT). Gridded Population of the World (GPW), version 3, Palisades, NY: CIESIN-Columbia University. Available at <http://www.ciesin.columbia.edu/gpw/>. NOTE: National boundaries are derived from the population grid and thus may appear jagged.

Deforestation

When LPG ↓ Does Deforestation ↑

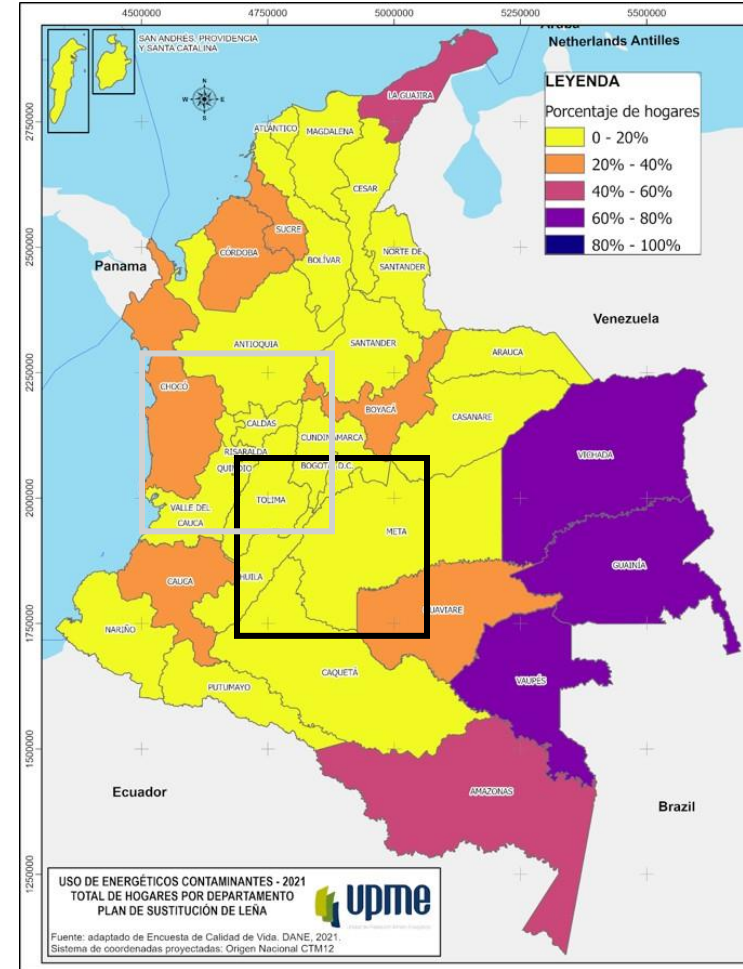


Data Time Period: May 2015 to May 2024

Deforestation Source: Normalized Density Vegetation Index (NDVI)

MODIS/Terra Vegetation Indices 16-Day L3 Global 250m SIN Grid V061

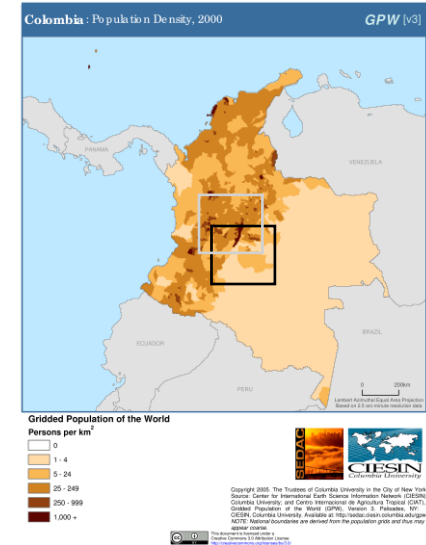
Percentage Using Inefficient Fuels for Cooking



Agenda

1. Introduction
2. Energy Ladder
3. Questions
4. LPG Demand
5. Air Pollution
6. **Deforestation**
7. Conclusion

Population



Conclusion

Agenda

1. Introduction
2. Energy Ladder
3. Questions
4. LPG Demand
5. Air Pollution
6. Deforestation
7. **Conclusion**

- **Do higher LPG prices** lower LPG demand?
 - **Yes**, based on evidence in the data
- **Does air pollution increase** when LPG demand decreases?
 - **Yes**, based on evidence in the data
- **Does deforestation increase** when LPG demand decreases?
 - **Yes**, based on evidence in the data

The question becomes ...

How can Colombia and other countries lower the cost of LPG, as fossil fuel production declines?

Can **renewable LPG** at scale provide cost benefits similar to sugarcane ethanol vs gasoline or wind & solar vs coal?



Thank You

brendan.doner@breathetransport.com

<https://medium.com/@brendandoner/can-propane-save-lives-1d5832d23fe4>

https://github.com/brendandoner-breathetransport/lpg_analysis/blob/master/README.md