



Analysis of Alternative Fuels for Transportation

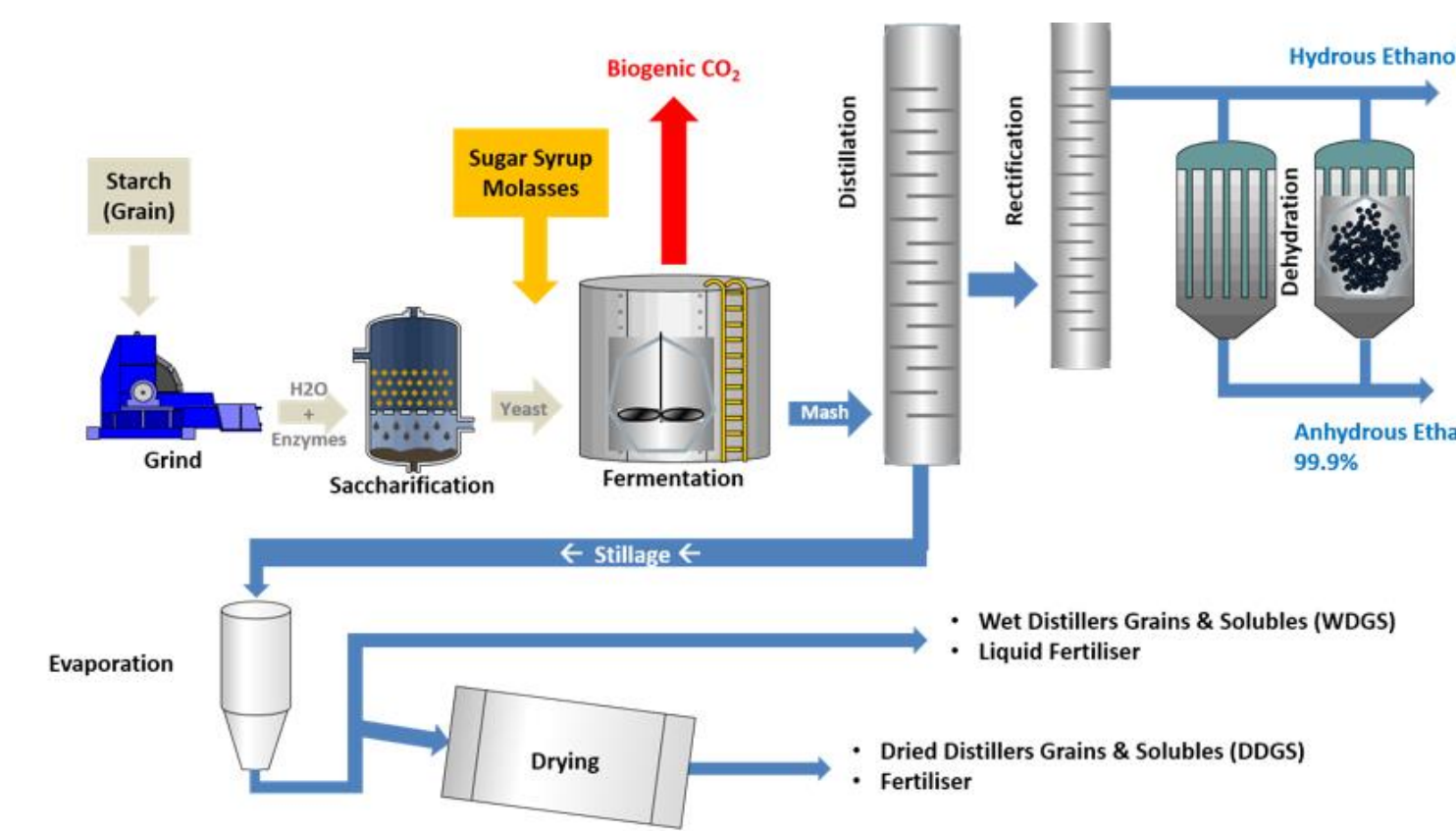
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Abstract

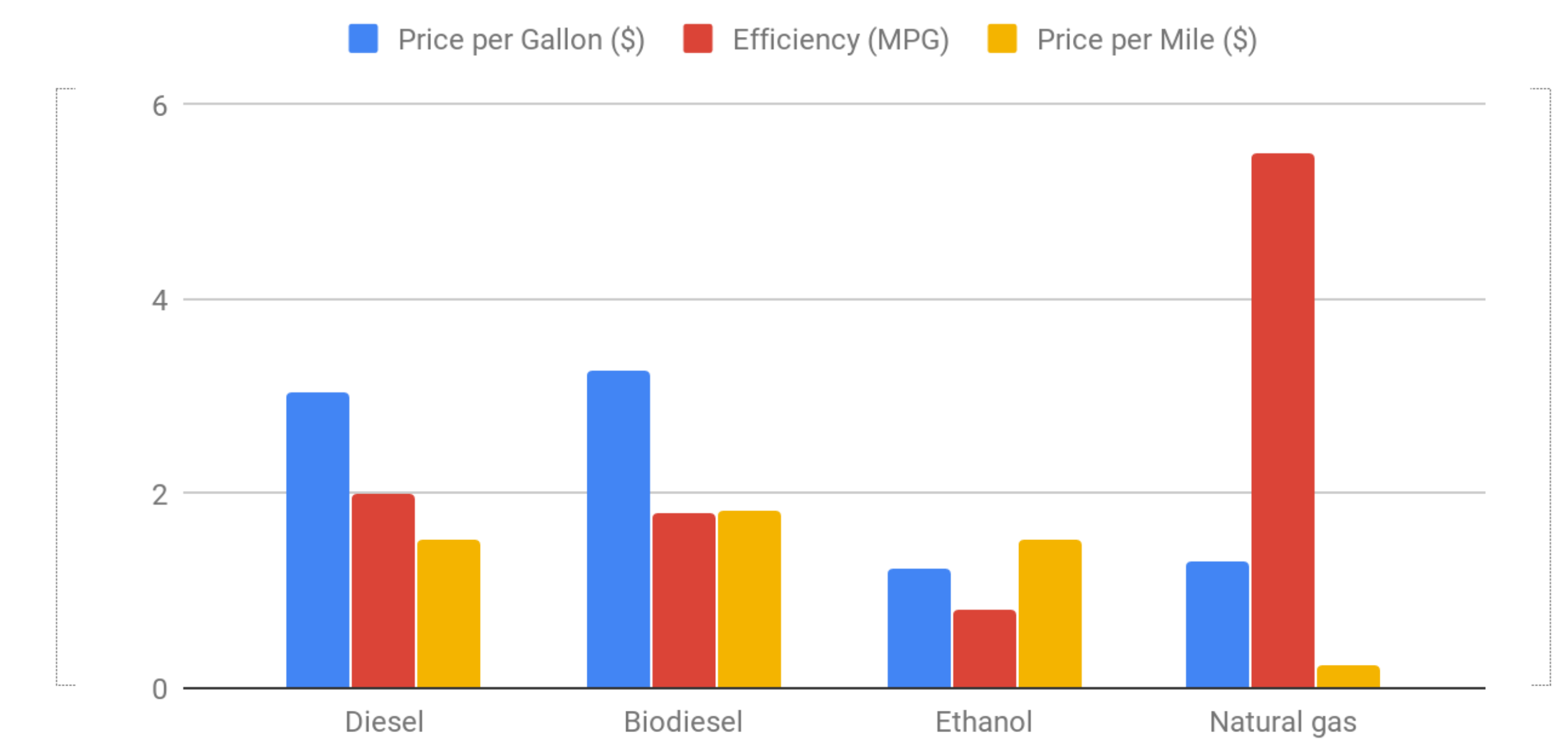
Making transportation efficient and less harmful for the environment has been an ongoing goal for numerous companies and government organizations. In the last decade, there has been a push to replace the current infrastructure surrounding internal combustion engines (ICE's) running on traditional gasoline/diesel fuels. This project examined three alternatives including ethanol, biodiesel, and natural gas comparing efficiency data with various implications that converting to these methods may entail. Specifically, the costs associated with these changes were studied in regards to Cleveland's mass transport system (RTA). By collecting and organizing existing data, this information can be presented to initiatives trying to find better methods to power transportation for the future.



Ethanol



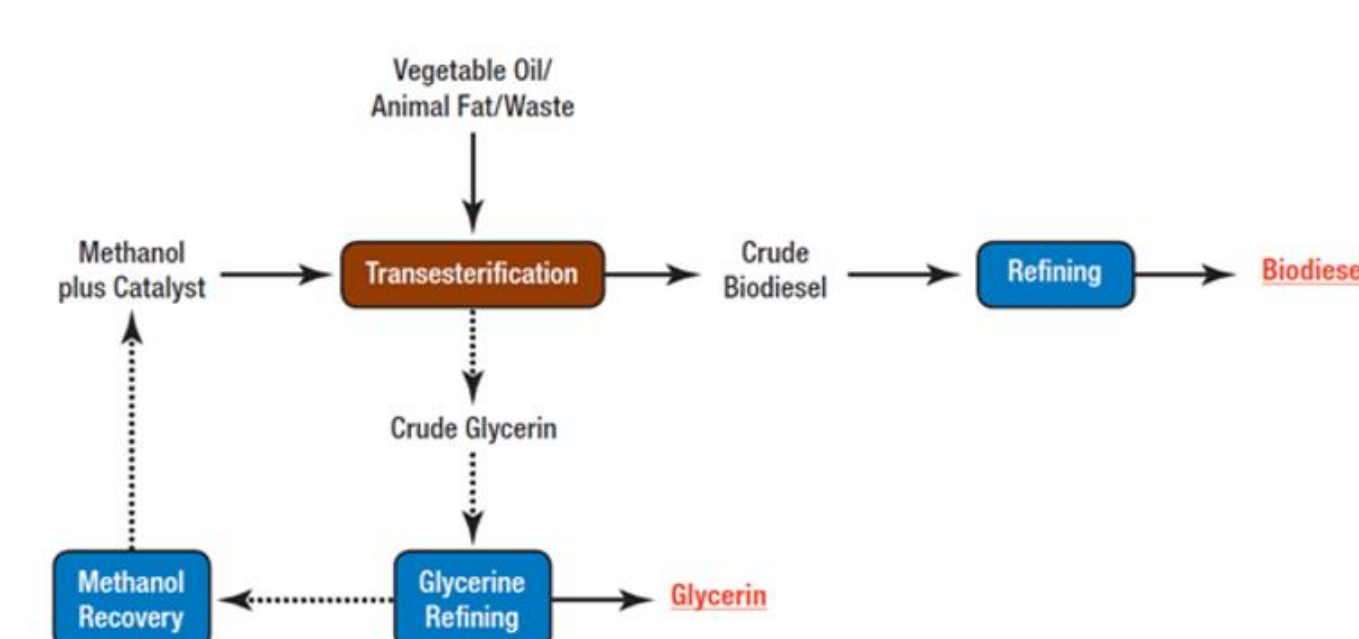
Price per Gallon (\$), Efficiency (MPG) and Price per Mile (\$)



Objective (Current Problem with Diesel)

- Burning diesel is harmful to the environment and produces high amounts of greenhouse gasses
- Diesel is not as efficient as some alternative fuel sources
- The process of refining oil to produce suitable diesel fuel is costly and also leaves a large carbon footprint
- The costs will rise as diesel comes from nonrenewable resources

Schematic of Biodiesel Production Path



Biodiesel



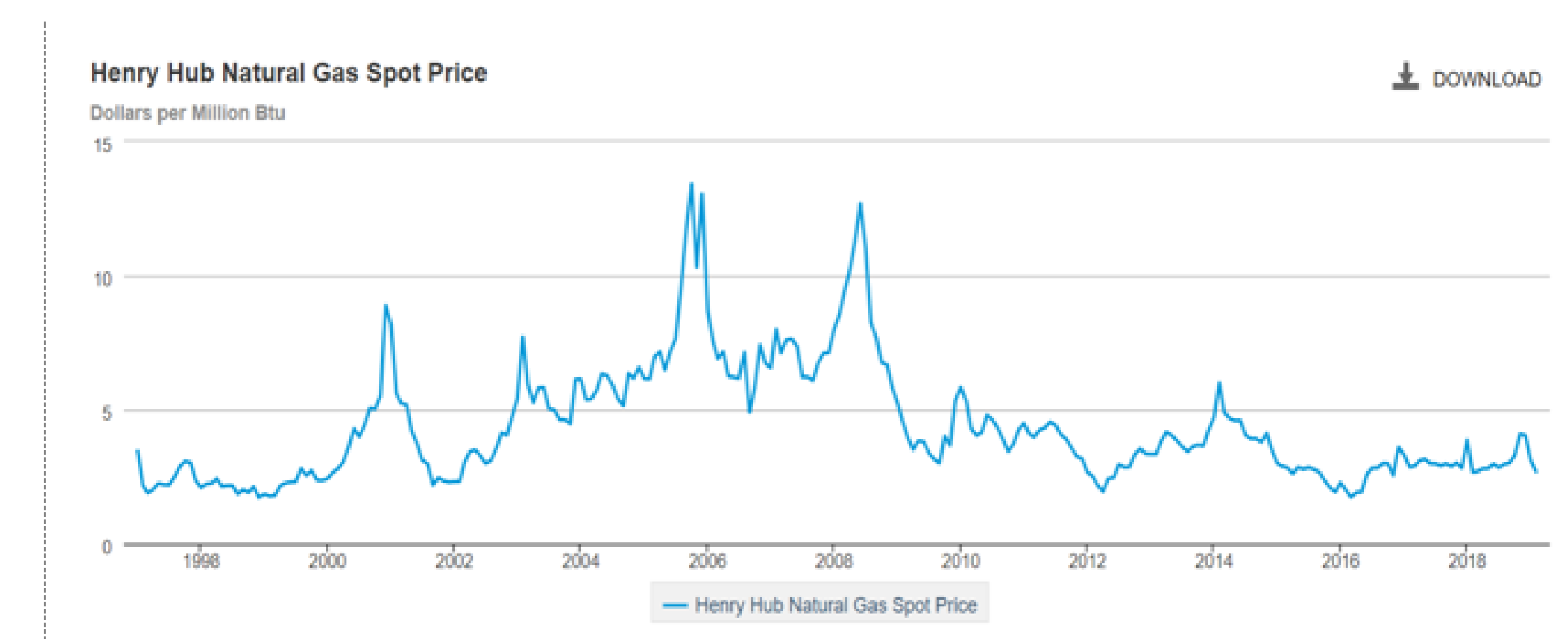
Conclusion

After collecting numerous statistics and efficiency data, it is concluded that converting Cleveland's RTA system to run on natural gas would likely be the superior option over staying with diesel or switching to ethanol and biodiesel. Northeast Ohio, unlike other regions across the nation, has cheap access to natural gas and because this fuel is more efficient as well as less polluting, it is worth converting to. Using various biodiesels would also be cleaner to burn than regular diesel, however the slightly lower cost per gallon does not make up for the large decrease in efficiency. Similarly, an ethanol blend produces less pollution and is actually much cheaper than an equivalent amount of diesel. However, it is by far the least efficient fuel source and this completely negates any cost advantage gained by converting. Even though most of the advantages/disadvantages of each fuel will largely be similar, different locations should calculate the costs associated with each to determine which is the most effective choice.

Advantages/Disadvantages

	Diesel	Biodiesel	Ethanol	Natural Gas
Advantages	No modification or changes to existing infrastructure	Environmentally Friendly Less Dependent on Foreign Oil Can be used with little to no modification in engines Biodegradable	Environmentally Friendly Less Dependent on Foreign Oil Made with food unfit for human consumption (2nd generation)	30% less greenhouse gasses and 85% less carbon emissions Produced in the state
Disadvantages	22.3 pounds of CO2 are produced per gallon of diesel burnt	Quality can greatly vary depending on source of fuel Not suitable for low temps More demand for food products (Soybean and Rapeseed)	Quality depends on source used. (1st generation vs 2nd generation) Usually blended with diesel for engines to function More demand for food, including food staples for first generation	Fracking causes damage to the environment and contaminates groundwater

Natural Gas Costs



Reference

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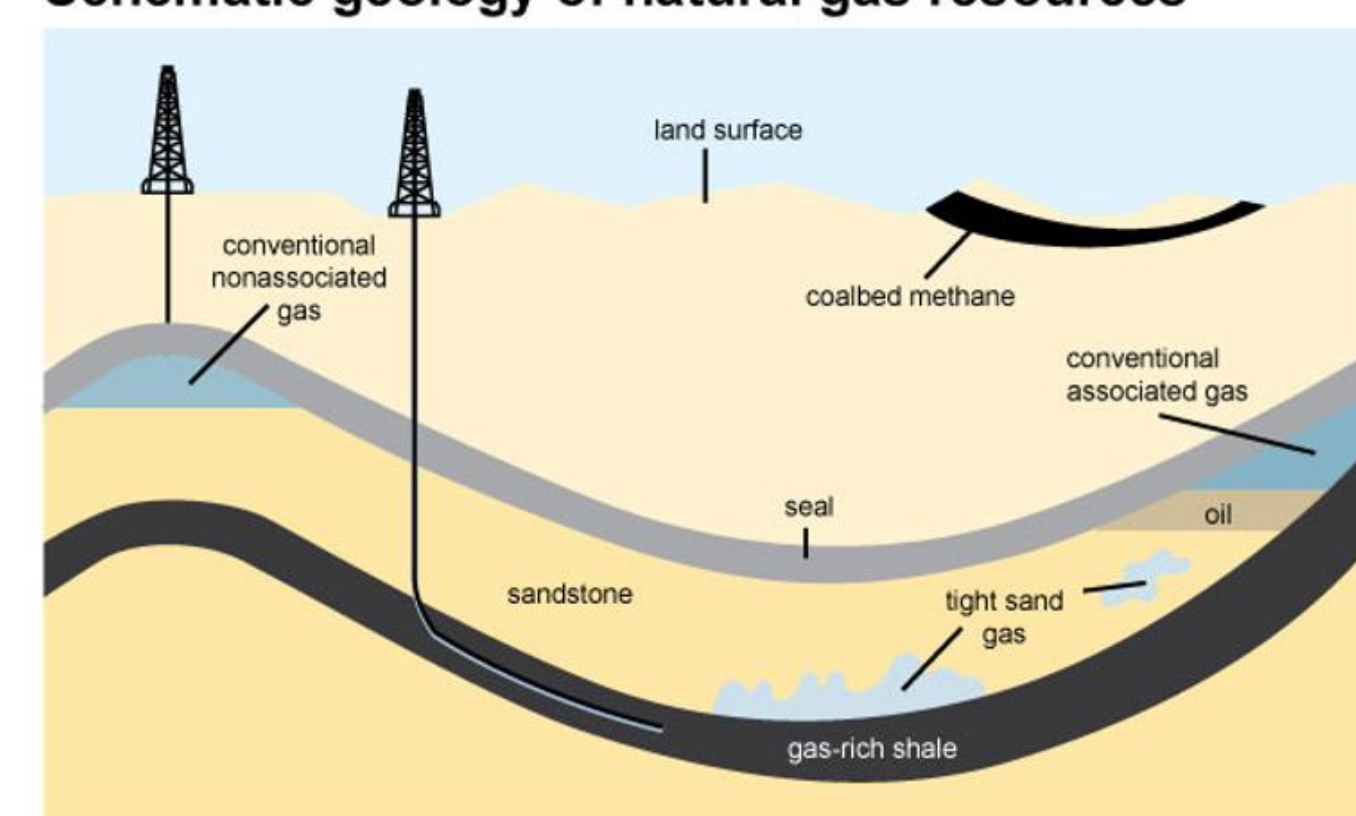
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Schematic geology of natural gas resources



Natural Gas



Raw Material Costs (Ethanol/Biodiesel)

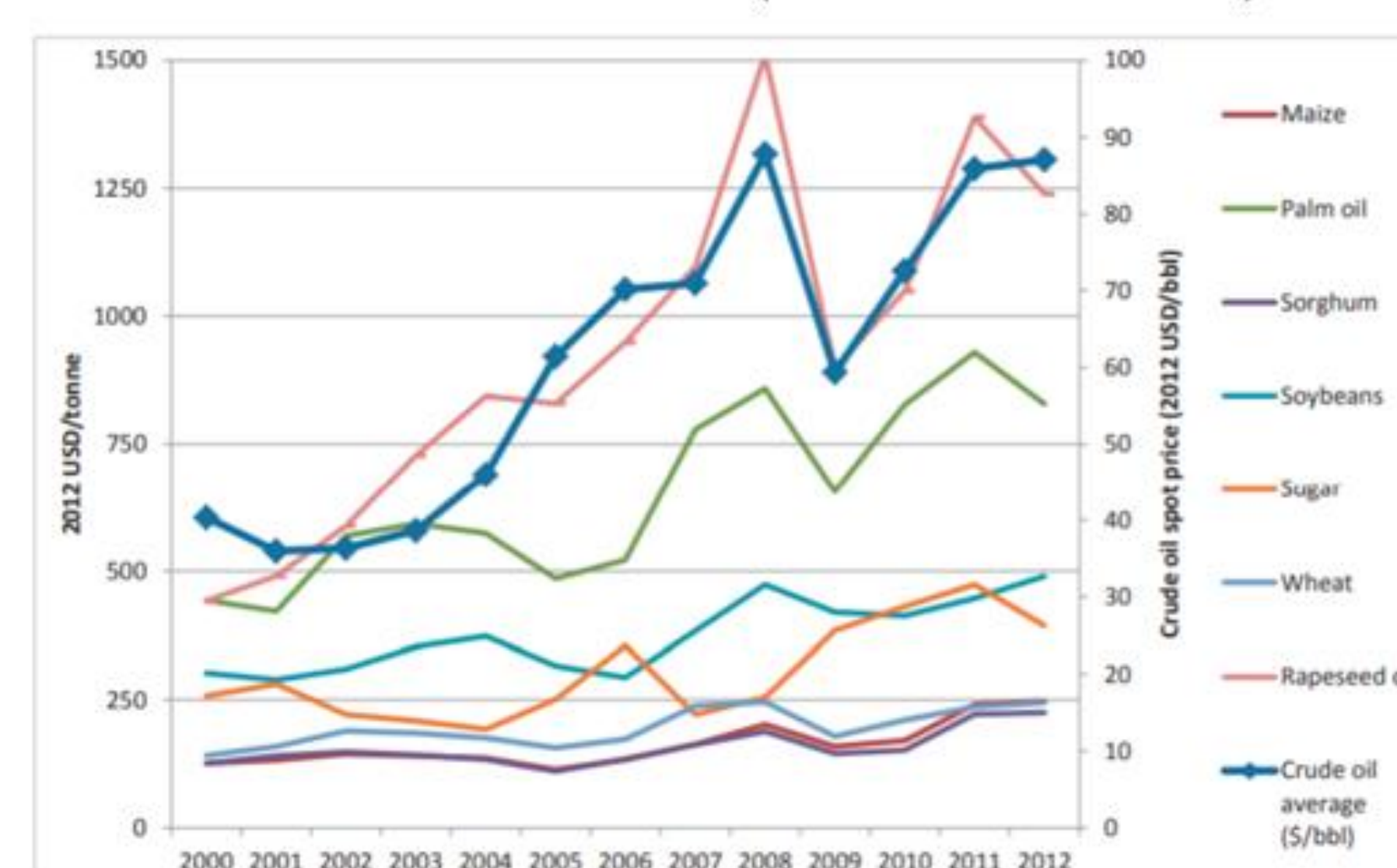


Figure 4.7: Global prices for food-based biofuel feedstocks and crude oil, 2000 to 2012. Source: World Bank, 2013.

Acknowledgments

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