# Using Mathematical Programming to Determine a Carbon Efficient Frontier


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## Introduction

•On an annual basis, the agriculture sector contributes 50% of the total anthropogenic methane emissions and 75% of the total anthropogenic nitrous oxide emissions.

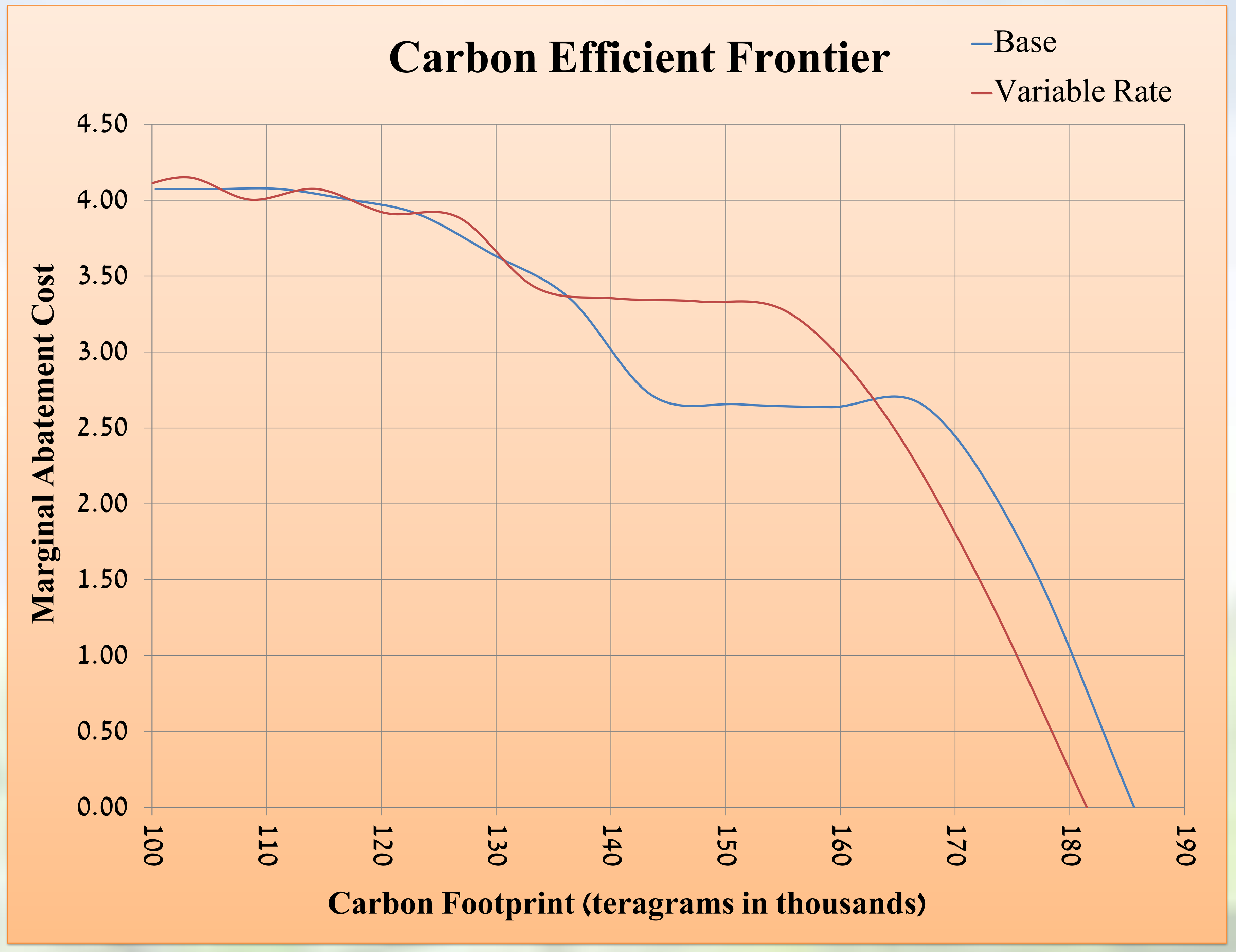
•Previous work by the authors found that certain precision agriculture technologies are both economically viable and reduce the amount of anthropogenic greenhouse gas emissions through decreased fuel consumption and reduced inputs.

•This Pareto optimal result lead the authors to further the research by exploring a carbon efficient frontier with different production practices.

## Objective

•This frontier will depict the most favorable carbon footprint possible for differing levels of expected net returns, illustrating the relative marginal abatement cost associated with the carbon footprint of the producer.

•This frontier will give producers and policy makers information that will be helpful in determining the appropriate policies, procedures and technologies for reducing carbon emissions in the agriculture sector.




## Methods

•A whole farm analysis using a resource allocation model of a Henderson County, Kentucky corn and soybean farmer was utilized.

•A biophysical simulation model using 30 years of historical data from Henderson County, Kentucky provided estimates for corn and soybeans yields.

•Variable rate technologies were employed to allow the optimal mix of production practices to reduce the carbon footprint and enhance the net returns above specified costs. Variable rate planting for both corn and soybeans and variable rate fertilization for corn were utilized in the model.

## Results

• The variable rate planting allowed for shifts in soybean production practices, specifically plant population, enabling that technology to be more carbon efficient than conventional planting practices.

•The changes in seeding at different plant population levels drive the optimal choice of planting dates that are available.

•The adjustment of fertilizer used on corn at different acreage levels was key in reducing the carbon footprint.

## Conclusion

• Incentive programs that price carbon abatement may lead to different emission levels depending on the production method. If incentives were to be in the 2.60 to 3.40 range, then a base production farm would have a lower carbon footprint than a VRT farm, which is a counter-intuitive result.

•This information can be used to determine, based on the current carbon footprint of a farm, the optimal production practices to be used to reduce the carbon footprint of a farm.