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## Background

### Objectives:

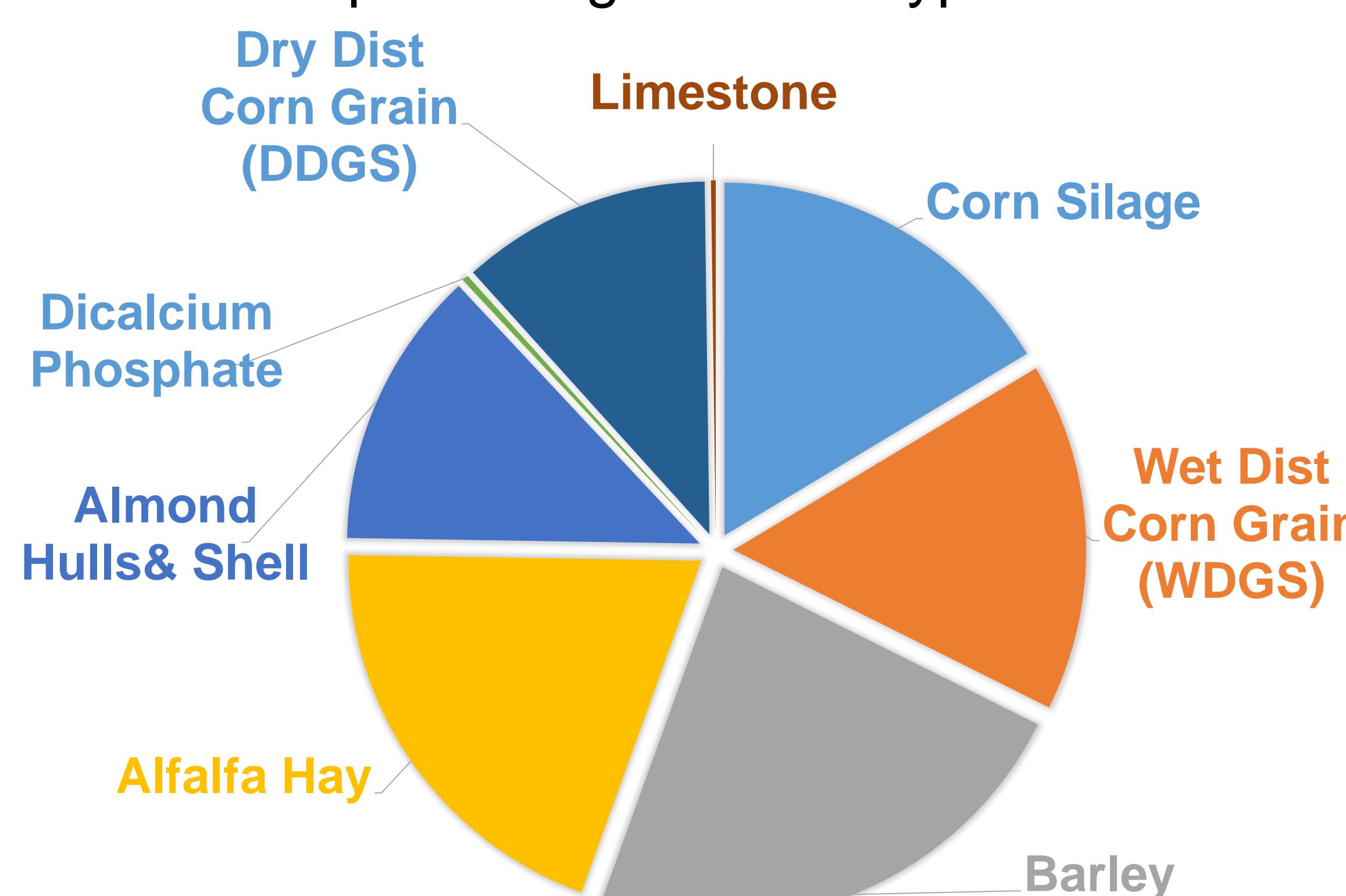
- (1) To evaluate the performance of two biofuel co-products as dairy cattle feed in California; and,
- (2) To assess the displacement credit of the two co-products as feed.

### Biofuels and Co-products

- Biofuel production systems produce multiple co-products or by-products.
- Livestock feed is a major application for many co-products from biofuel production systems.
- Co-products are critical for determining biofuels' performance in LCA and in LCA-based policies such LCFS.

### California Situation

- The largest milk production state
- Large agriculture market provides a variety of fodder crops and agricultural byproducts



DEFAULT DAILY FEED RATION OF DAIRY CATTLE (CA)

### Approach

- Understand feeds used for dairy cattle in California.
- Conduct life cycle inventory assessment of California feedstuffs.
- Calculate feeds displaced by biofuel co-product using a feed ration calculator (PCDairy).
- Estimate life cycle GHG emissions and energy consumptions displaced by co-products for biofuel production.

## Displacement Estimation

### Two Co-products Studied:

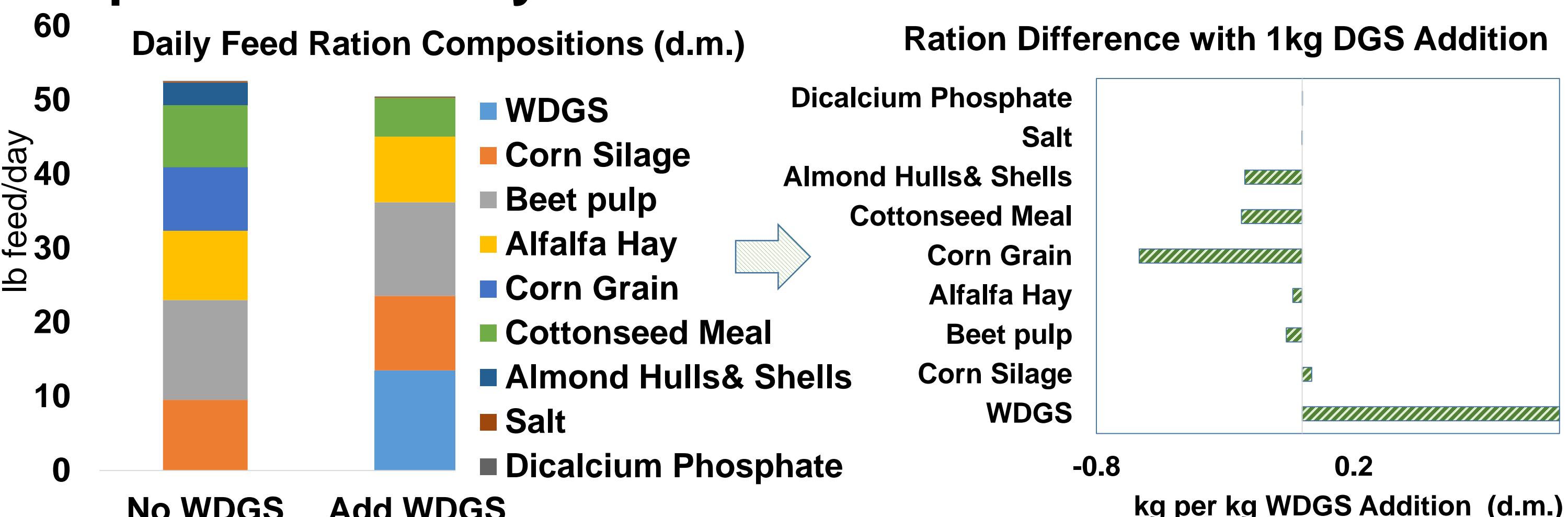
**Wet distilled grains and solid (WDGS):** the co-product from corn ethanol production facility and is primarily used as animal feed.



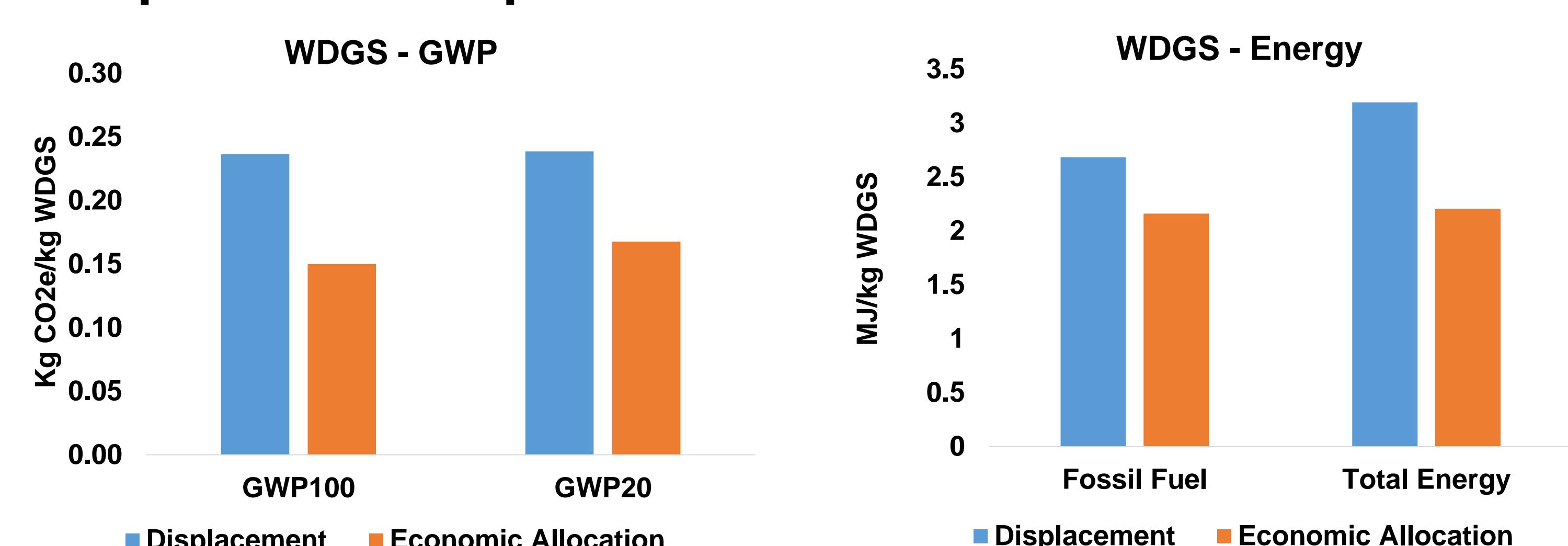
**Algal Cake:** the microalgae biomass residual after lipid extraction.



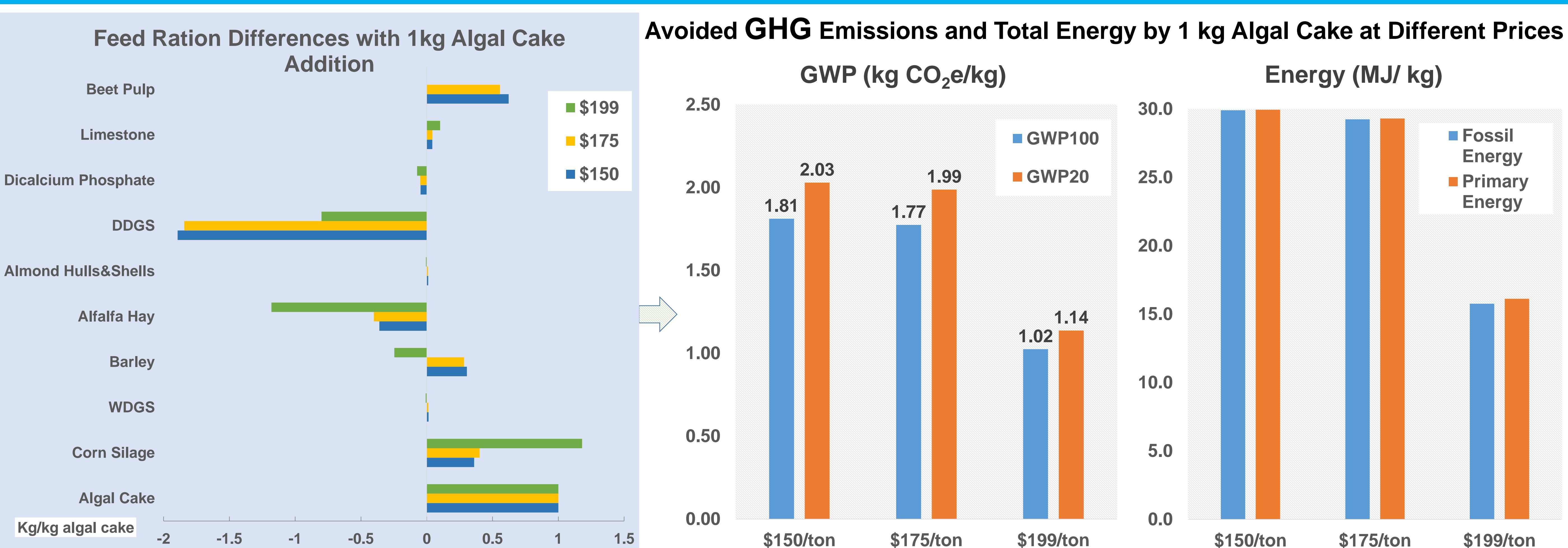
### Displaced Feeds by WDGS



### Comparison of displacement and economic allocation



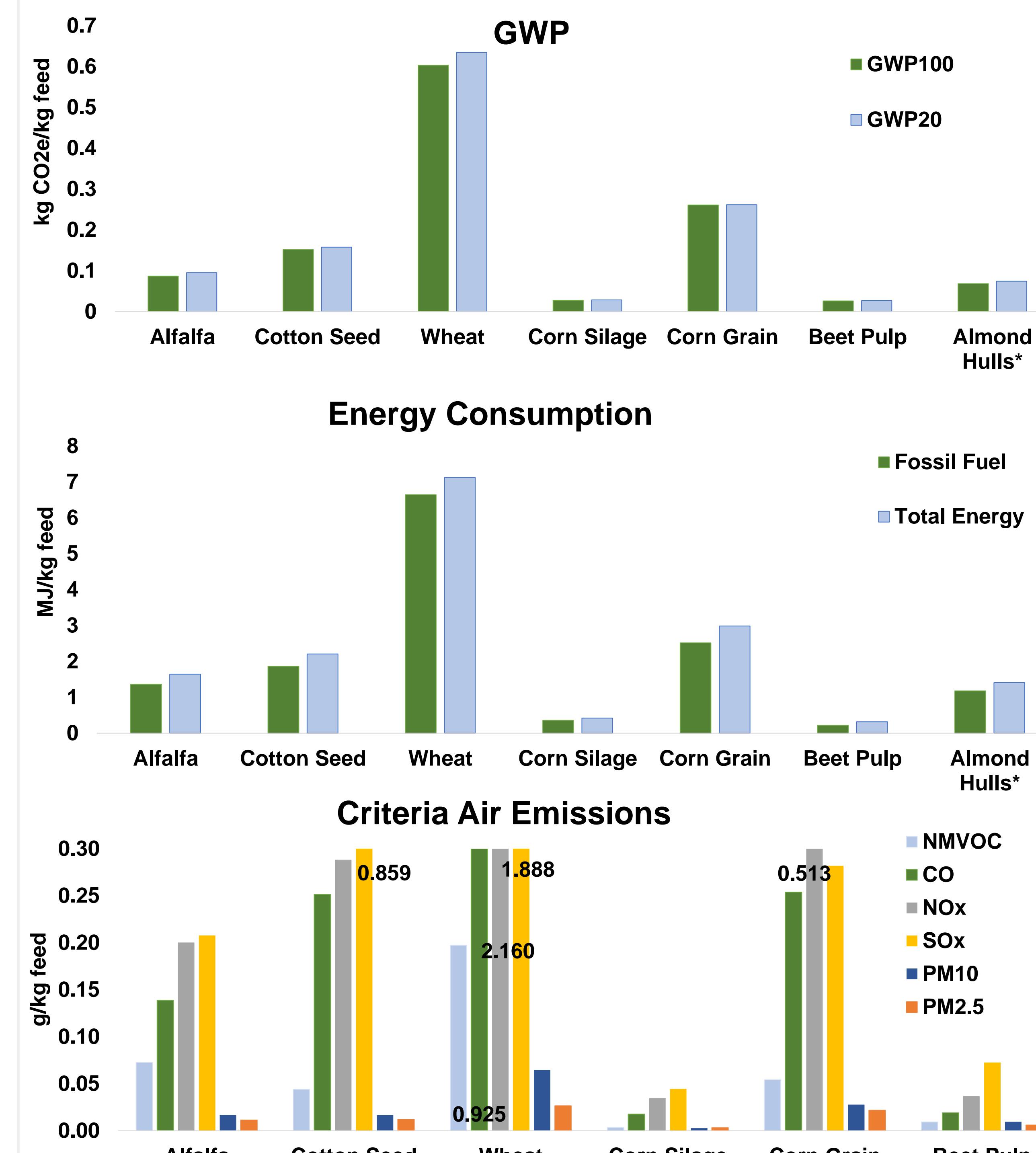
## Price Impacts on Displacement Results (Algal Cake)



### Contact the Authors!

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## LCI Results of California Feeds



\*LCI of California almond hulls and shells production was adopted from Kendall et al. 2015