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Life Cycle Analysis of Canola for Biodiesel Use: PNW perspective

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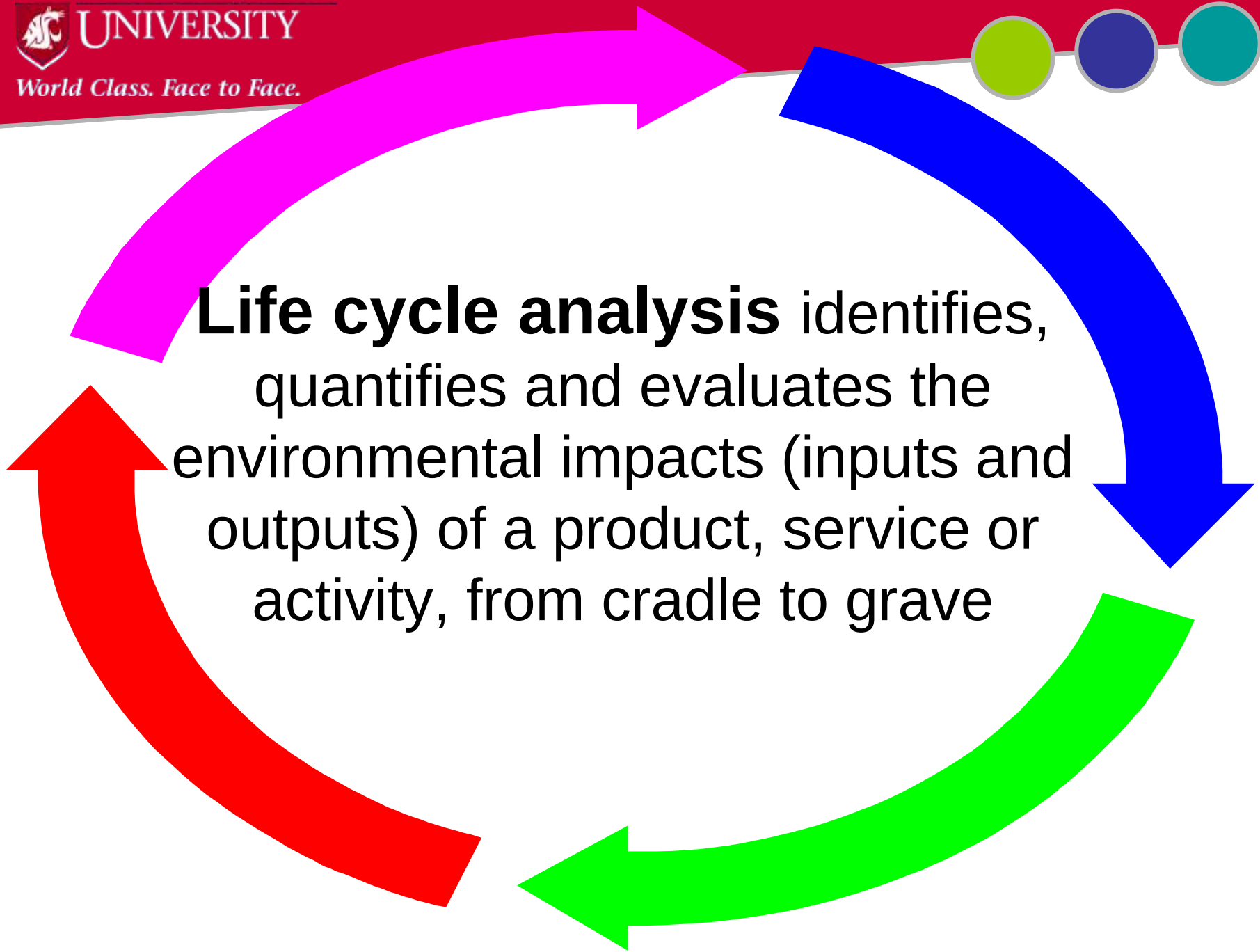
Topics

- What is Life Cycle Analysis?
- How has LCA helped inform sustainability questions of oilseed feedstocks to biofuels?
- Overview of EPA LCA canola
- Potential sources of regional variation on the national LCA



Life cycle analysis identifies, quantifies and evaluates the environmental impacts (inputs and outputs) of a product, service or activity, from cradle to grave

Overarching Goal

To make more informed decisions through a better understanding of the human health and environmental impacts of products, processes, and activities.

U.S. Federal Requirements for biomass based diesel

- **'lifecycle greenhouse gas emissions'** from feedstock generation or extraction through the distribution and delivery and use of the finished fuel to the ultimate consumer, must affect a 50% reduction relative to GHG emissions from petroleum diesel

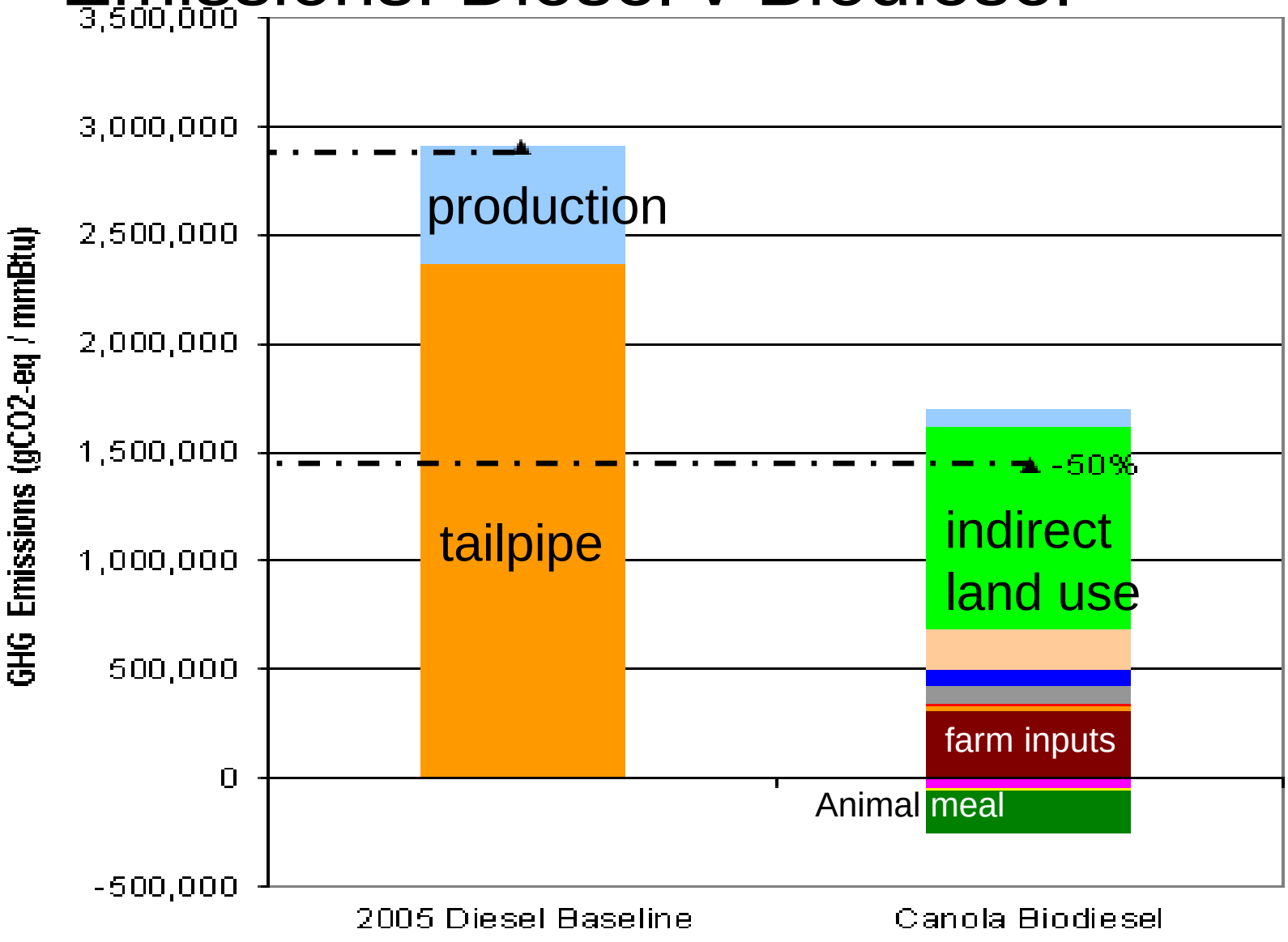
  -- Energy Independence and Security Act of 2007 (EISA)

EPA LCA employed models* that account for:

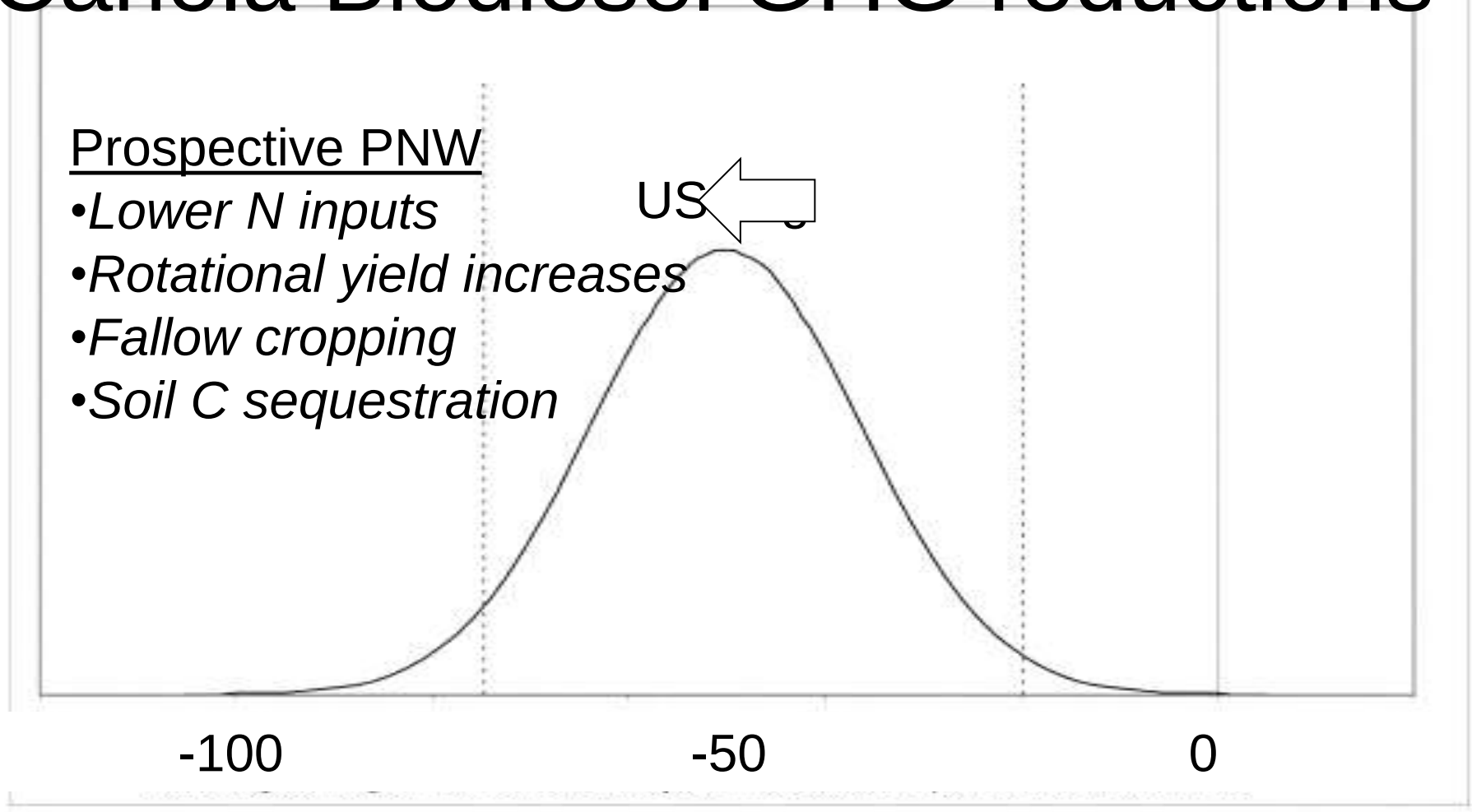
- Energy and emissions inputs for fuel and feedstock production, distribution, and use,
- Economic predictions of changes in agricultural markets
- Projected crop yield increases
- Land use changes resulting from feedstock production
- N_2O impacts from agriculture.

**Forestry and Agricultural Sector Optimization Model (FASOM) Texas A&M, Food and Agricultural Policy and Research Institute international models by the Center for Agricultural and Rural Development (FAPRI–CARD) Iowa State University.*

LCA Greenhouse Gas Emissions: Diesel v Biodiesel

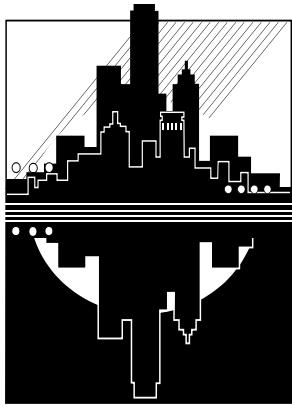


Canola Biodiesel GHG reductions



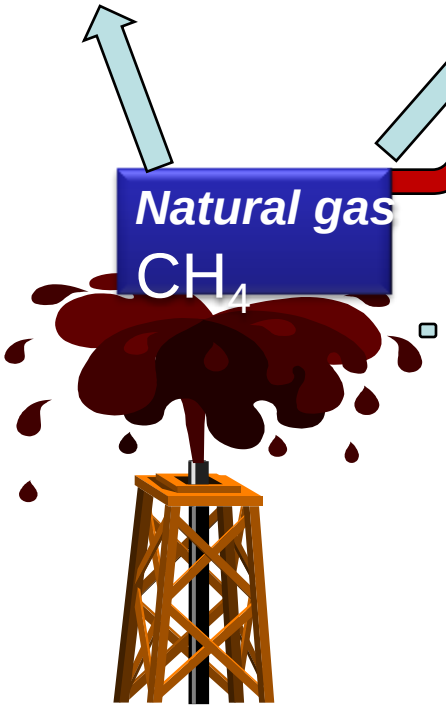
%change in biodiesel GHG Lifecycle emissions compared to diesel

CO_2, N_2O (Greenhouse gases)

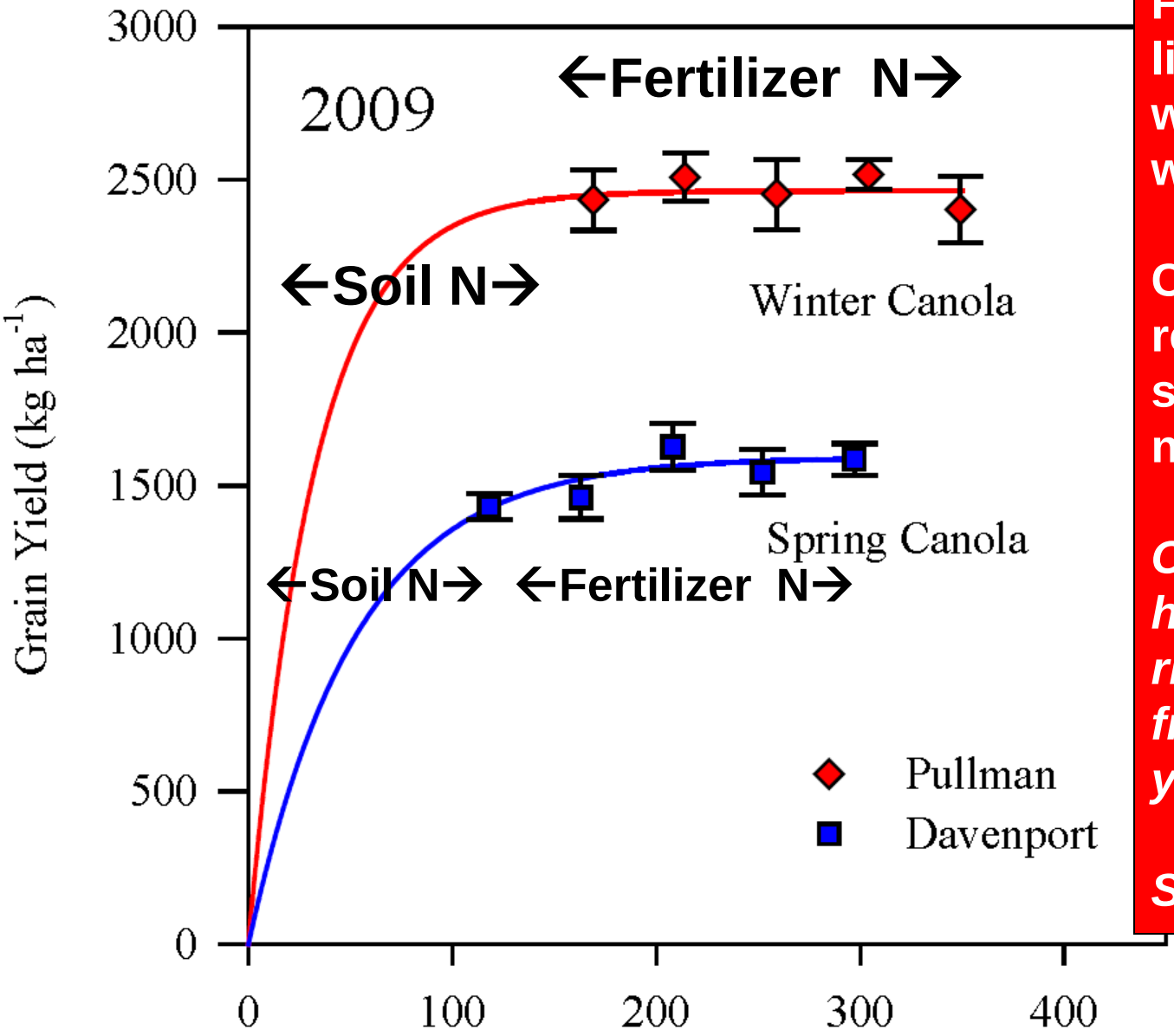


Haber-Bosch
1200C, 500atm

$3H_2 + N_2 \rightarrow 2NH_3$



Industrial N Fertilizer Production



Fertilizer N showed little ⇧ yield when soil N supply was high.

Canola scavenges residual soil N, minimizes need for fertilizer N.

Canola in rotation helps recover rResidual fertiilizer N from previous years

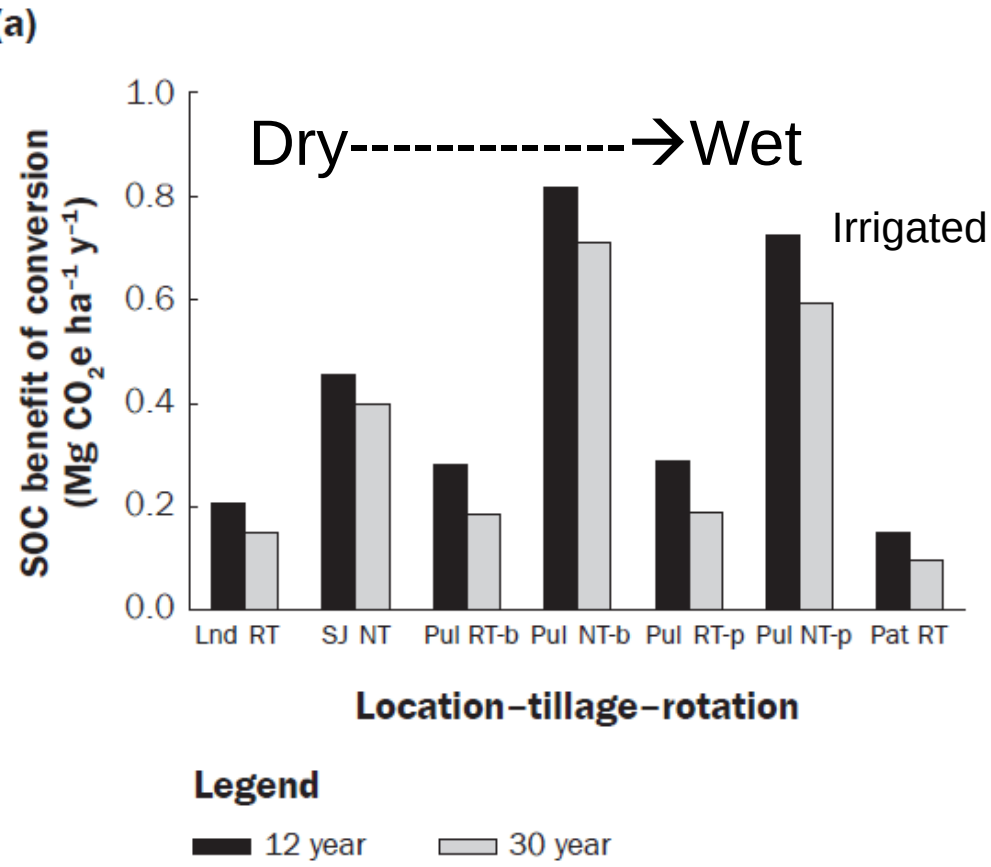
SOIL TEST PAYS!

Total N Supply = Soil N + Fertilizer N (kg ha^{-1})

Soil N = Mineralized OM + residual NO_3 + NH_4

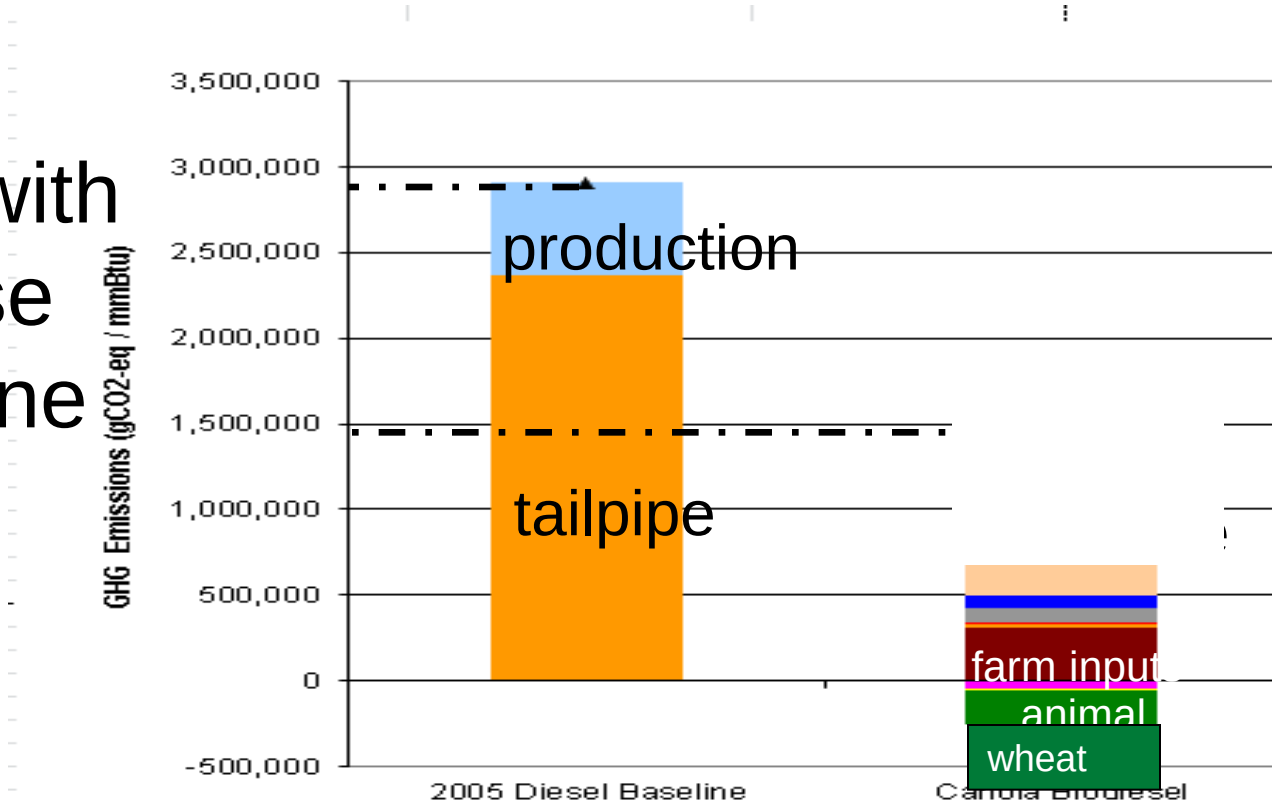
Soil Carbon Sequestration w/ Reduced or No-Tillage

- Canola produces high residue biomass.
- Reduced tillage/direct seeding stores soil carbon, reduces CO_2 emissions.



Higher GHG Reductions with Some Rotational Wheat Yield Increases and Oilseeds on Fallow

- No food production displacement with some fallow use in transition zone
- Compensating wheat yield increases in rotation



Other Sustainability Factors

- Improved farm economics
- Agronomic diversification
- Value added local industries
- High biomass, high lignin, low Si residues
- High N recovery

Summary

- EPA LCA is focused on reducing GHG reductions.
- iPNW canola production promises to reduce GHG emissions greater than US avg of 50% by
  - Lowering N fertilizer requirements
  - Reducing ILUC by replacing fallow
  - Production w/ reduced or no-tillage
  - Improving wheat productivity in oilseed rotations