Where Dirt and Policy Meet: The Economics of Soil Carbon

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Objectives

- Introduce the Notion of Carbon Markets
- Identify Key Economic Issues
- Briefly Discuss Tools
- Present Preliminary Results
- Hear from You About Contracts for Soil Carbon Sequestration

Why A Carbon Market?

- Emissions Reductions
  - Reduce CO_2 and other GHG
- Efficient Allocation of Emissions
  - Distribute the emissions efficiently across regions, countries, sectors, industries within sectors, and firms within industries
- Kyoto Protocol
  - Took effect on February 16, 2005

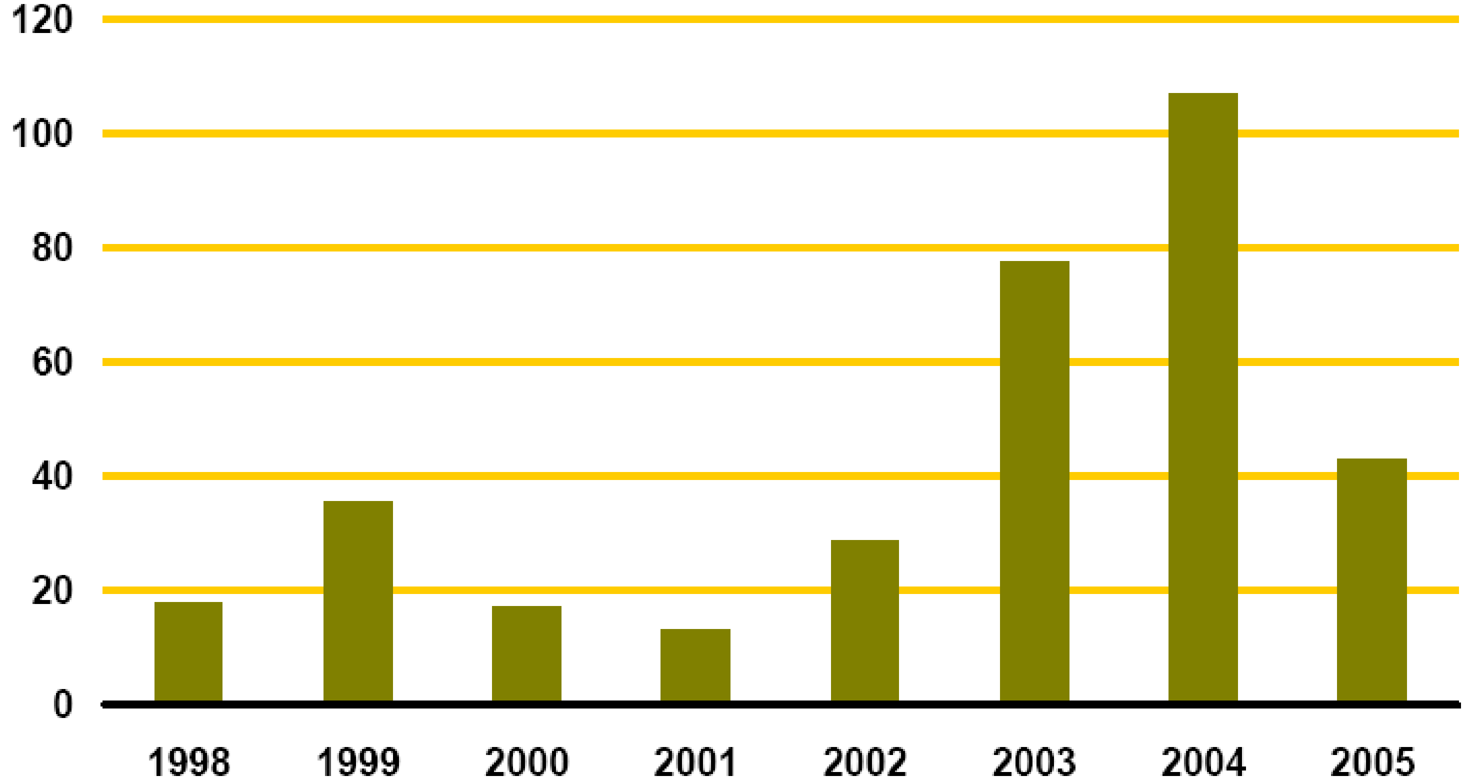
What Is Traded?

- Allowance-Based Transactions
  - Trading of government-issued allowances to emit GHG
- Project-Based Transactions
  - Trading emissions credits generated by projects that reduce GHG emissions

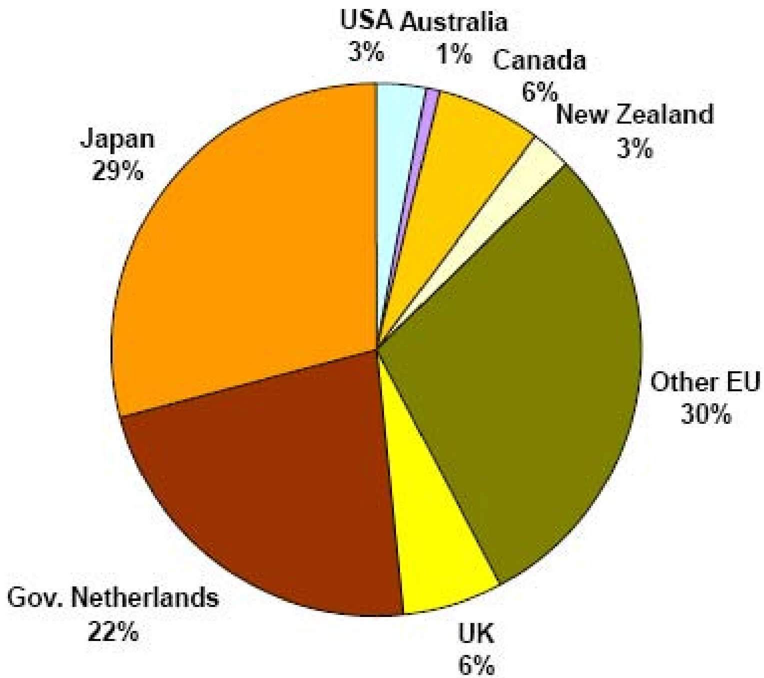
Carbon Market Volume

State and Trends of Carbon Market 2005

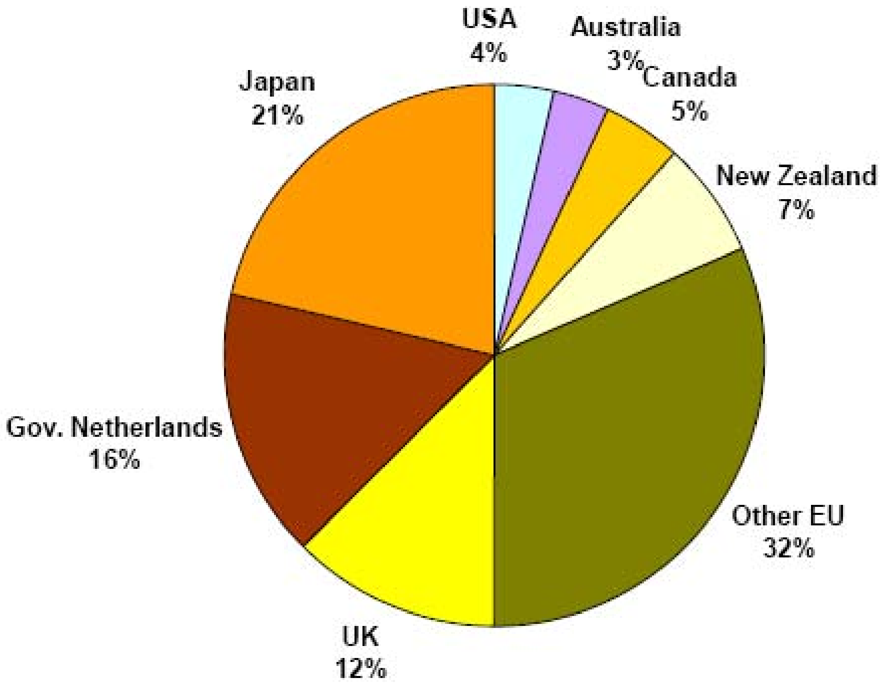
FIGURE 1: ANNUAL VOLUMES (million tCO_2e) OF PROJECT-BASED EMISSION REDUCTIONS TRADED (up to 2012 vintages)



Who's Buying?

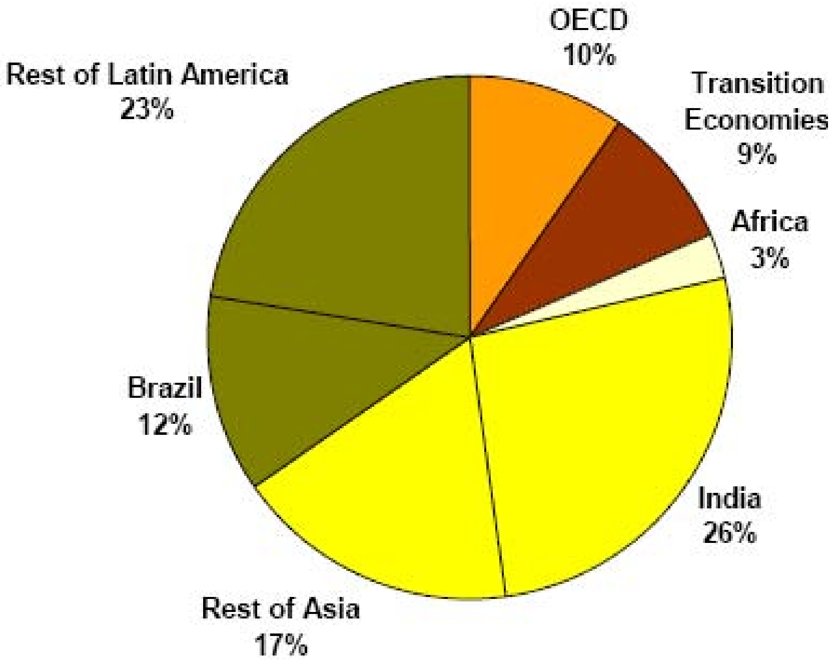


Jan. 2003 – Dec. 2004

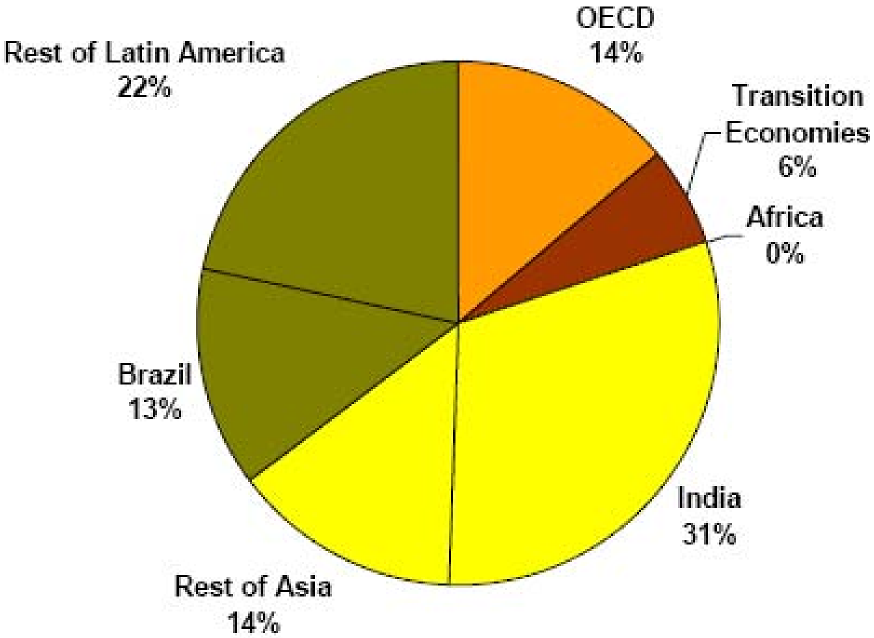


Jan. 2004 – April 2005

Who Is Selling?



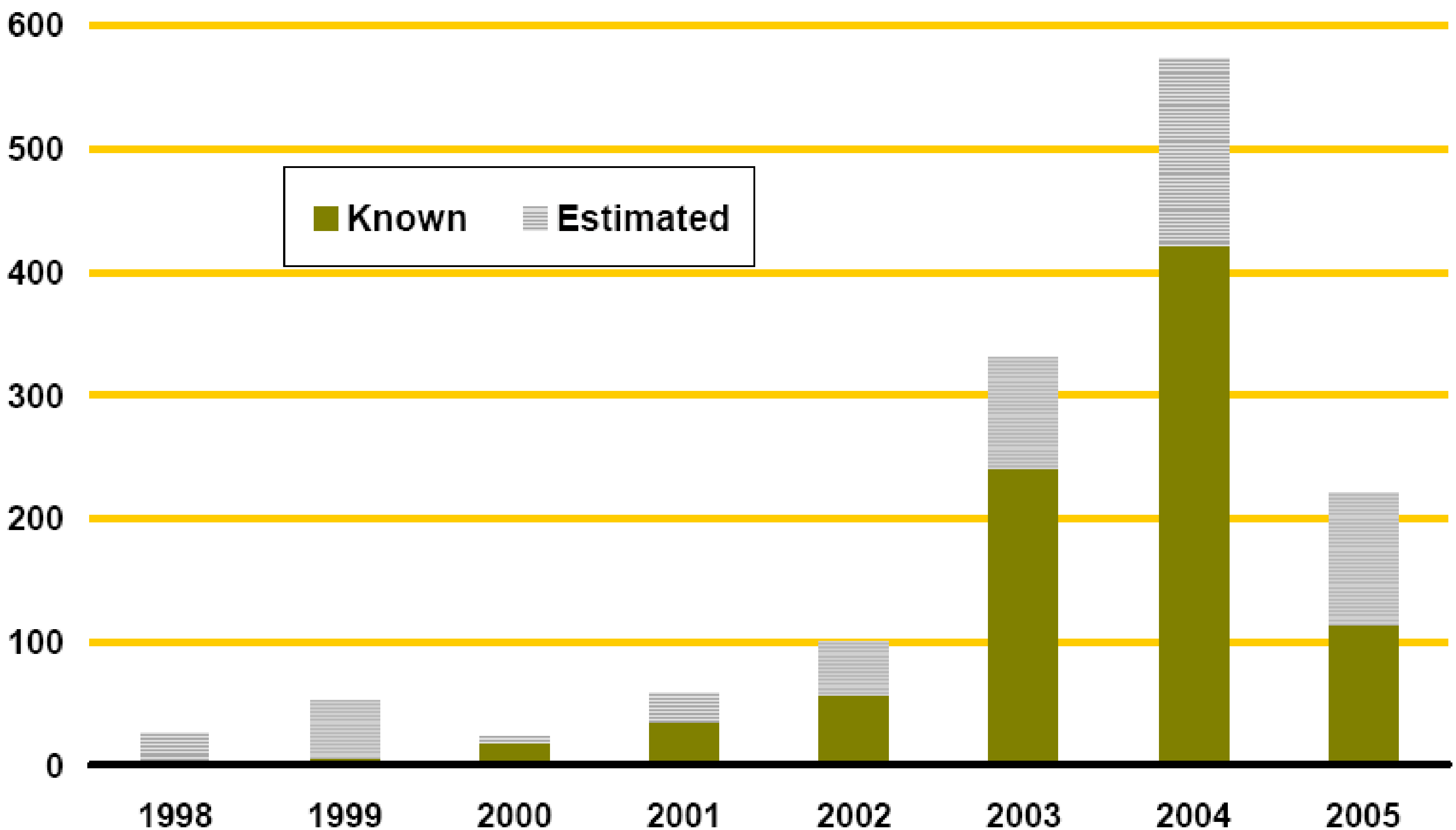
Jan. 2003 – Dec. 2004



Jan. 2004 – April 2005

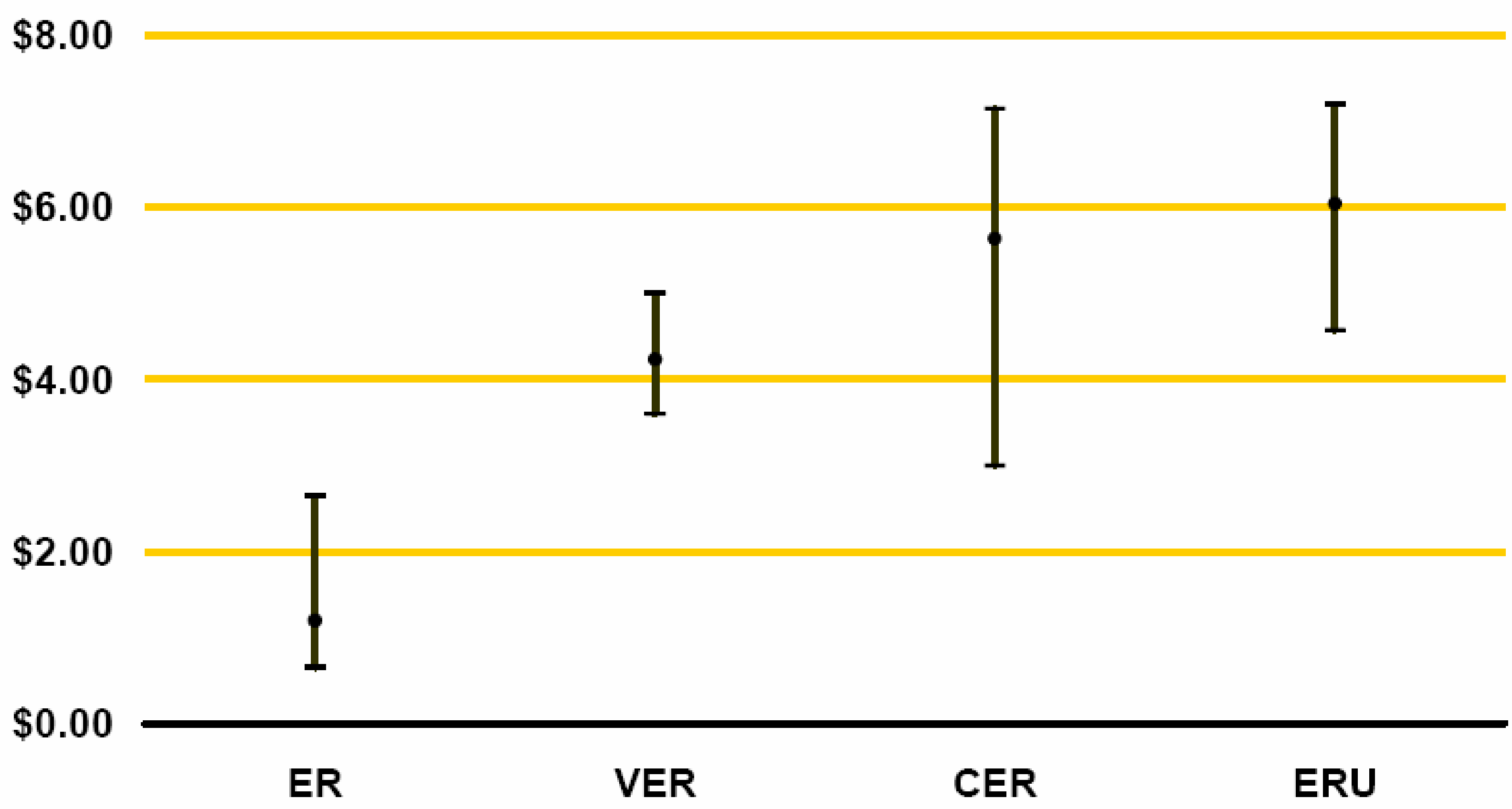
How Big Is the Market?

FIGURE 6: TOTAL MARKET VALUE (ESTIMATE) PER YEAR in million U.S. dollars (nominal)



Prices Paid for Carbon

FIGURE 5: PRICES FOR NON-RETAIL PROJECT-BASED ERs January 2004 to April 2005 (in U.S.$ per tCO_2e)



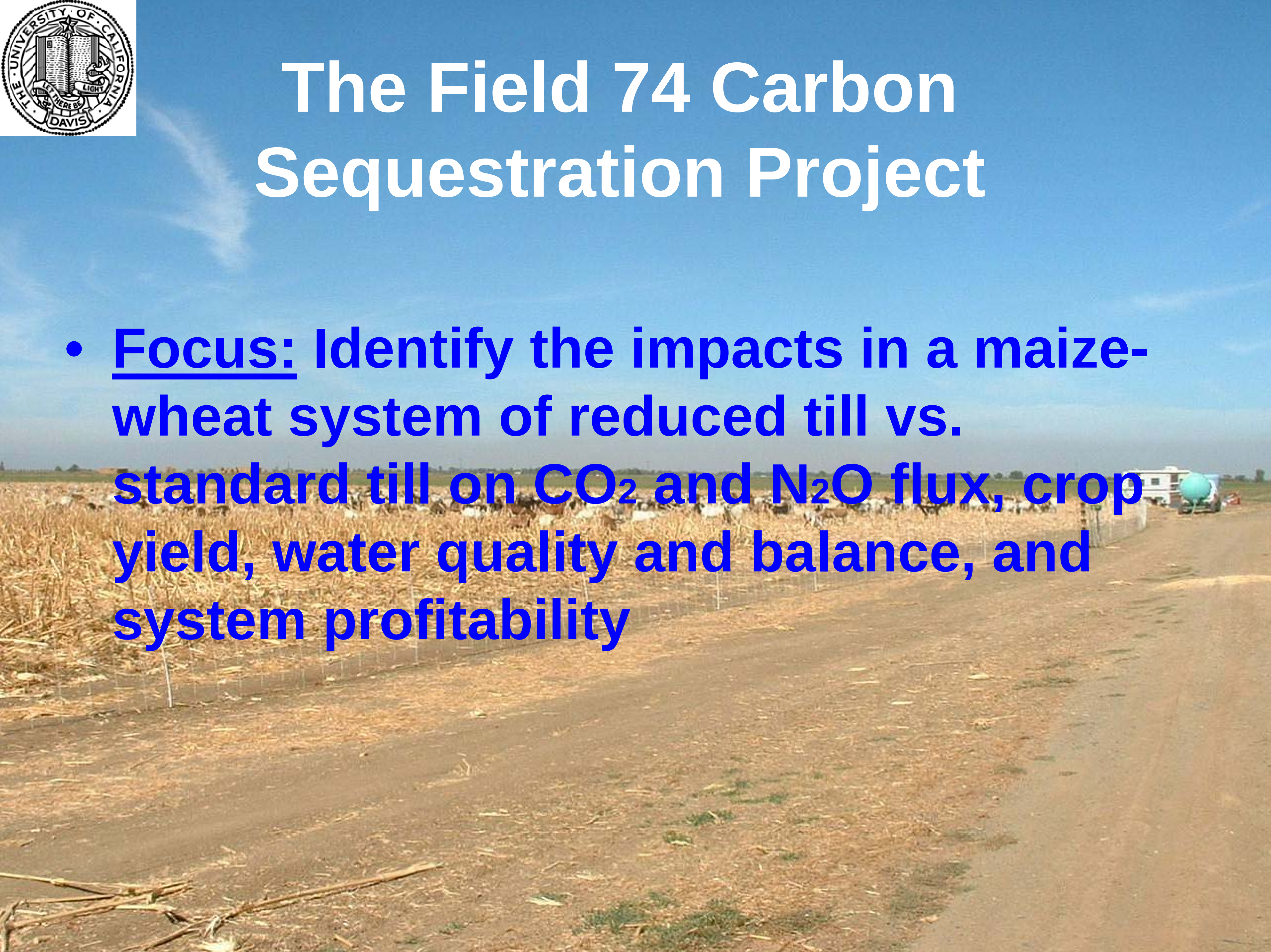
ER = Emission Reductions (projects); VER = Verified Emissions Reductions; CER = Certified Emissions Reductions; ERU = Emission Reduction Units

Key Economic Issues

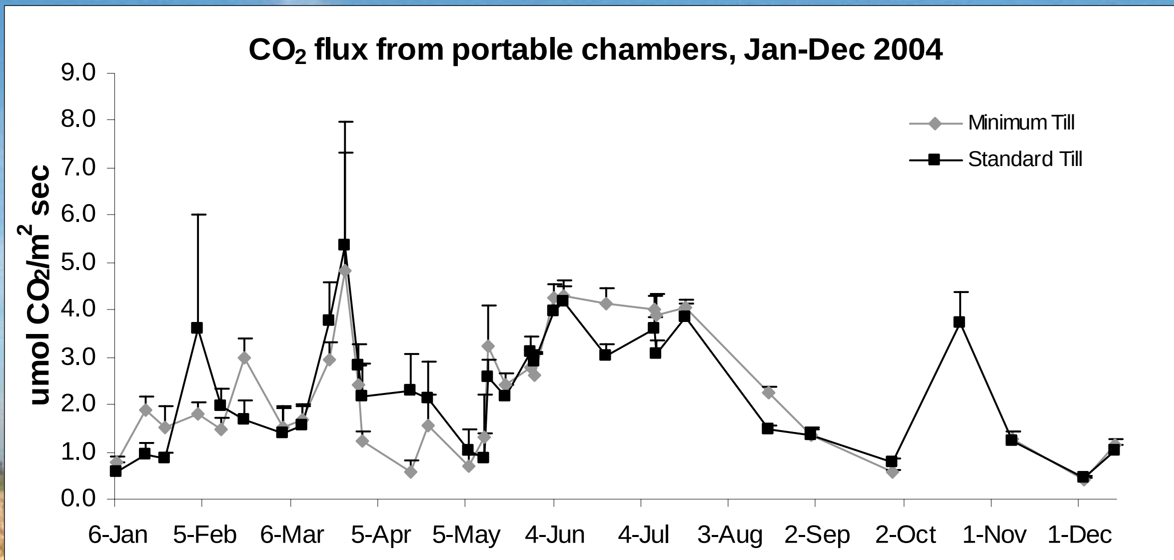
- Private Costs and Benefits
  - – Level of profitability
  - – Cash flow
  - – Changes in production costs
  - – Change in farmers' time requirements
- Social Costs and Benefits
  - – Types of costs; timing
  - – Types of benefits; timing; beneficiaries

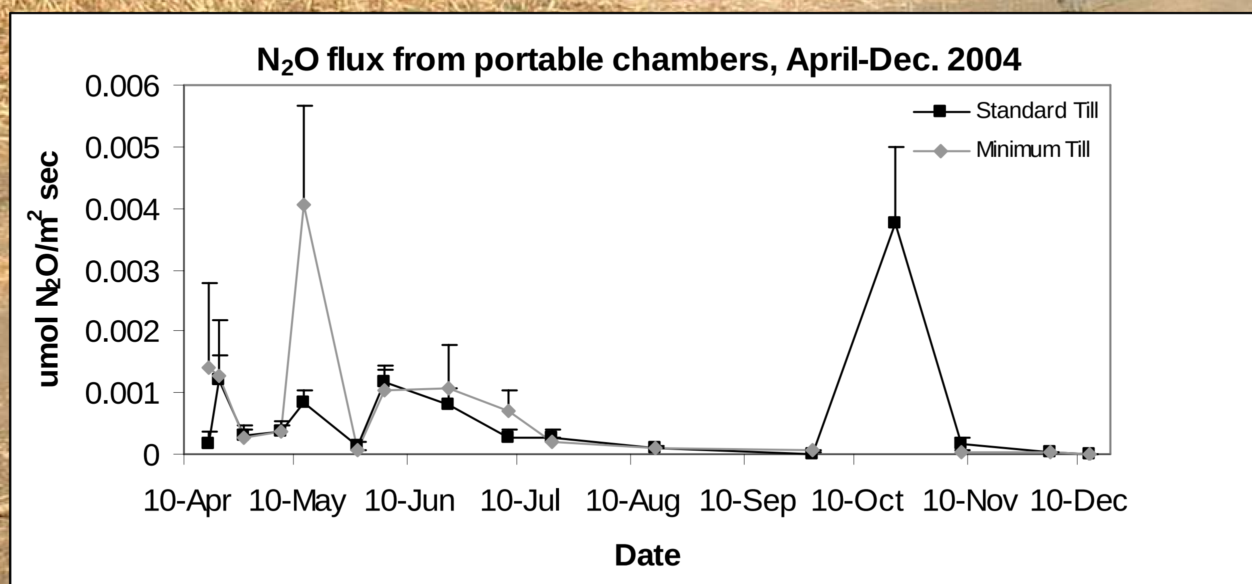
One Tool -- LUS Analysis

- **Focus on Land Use Systems (LUS)**
  - Multi-year duration
  - Different intermediate and end uses
- **Estimate Economic Effects**
  - Discounted streams of input <u>costs</u> and product <u>revenues</u>
  - Calculate economic <u>returns</u> to key factors of production
    - Land, labor
- **Estimate the Environmental Effects**
- **Estimate the Sociocultural Effects**
- **Highlight Institutional Impediments to LUS Adoption**


The Field 74 Carbon Sequestration Project
Focus: Identify the impacts in a maize-wheat system of reduced till vs. standard till on CO2 and N2O flux, crop yield, water quality and balance, and system profitability

CO_2 and N_2O flux

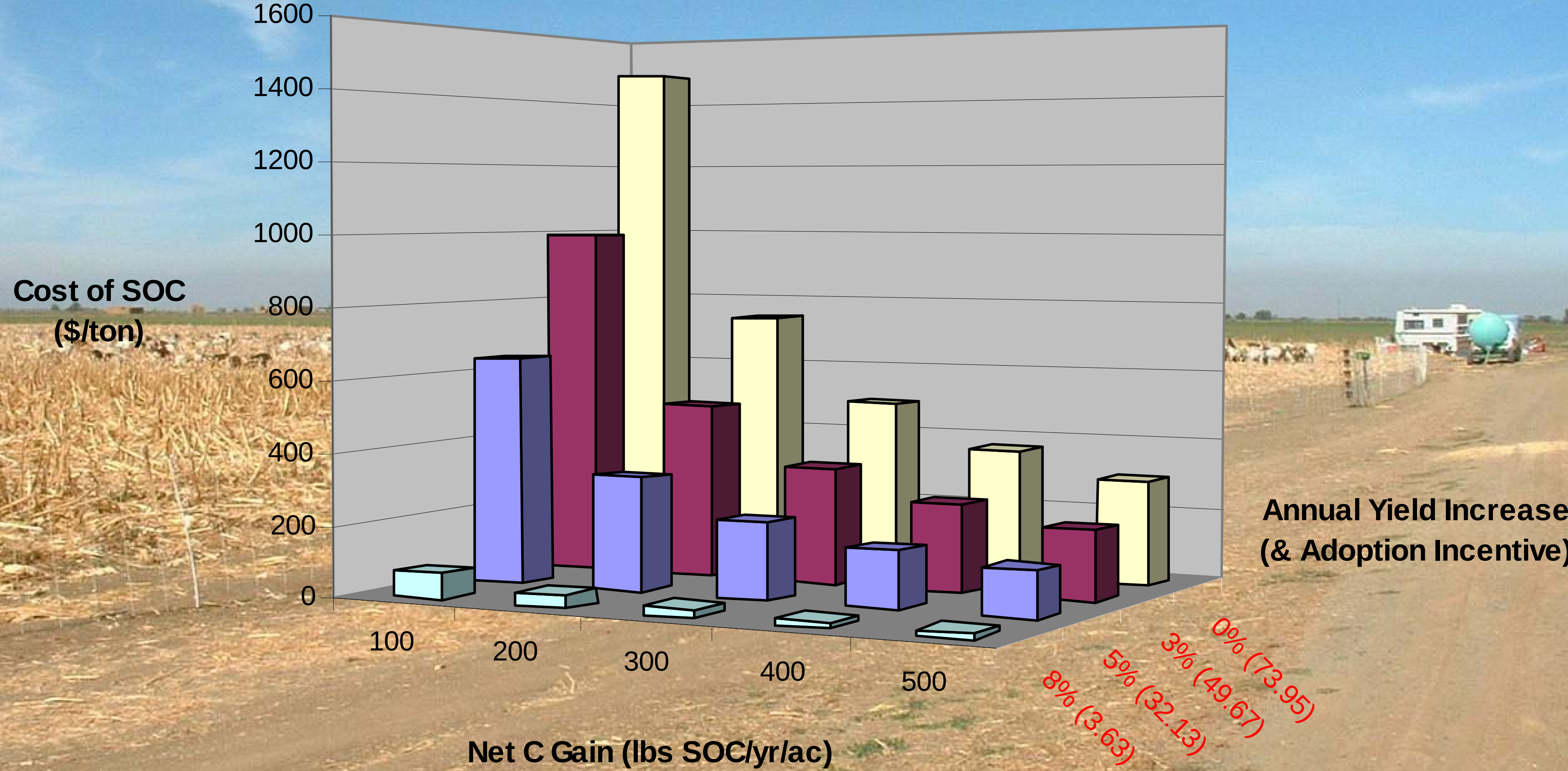




Yield and Profitability

- **Results to date**
  - **Yields declined sharply in year one**
    - **RT yield ➔ 3.64 tons/acre**
    - **ST yield ➔ 5.32 tons/acre**
  - **Despite reduced operational costs in RT system profits fell sharply**
    - **RT NPV/acre (7 years) ➔ $1022**
    - **ST NPV/acre (7 years) ➔ $1597**

Costs of Additional Soil Carbon in Field 74



C Sequestration in LTRAS Organic vs. Conventional Maize-Tomato Systems

LUS	Even Years	Odd Years
Conventional maize-tomato (CMT)	fertilized irrigated corn	fertilized irrigated tomato
Organic maize-tomato (OMT)	winter legume / irrigated corn compost / no pesticides	winter legume / irrigated tomato compost / no pesticides

- **<u>Focus</u>: Identify the effects of organic (vs. conventional) management of a maize-tomato rotation over 9 years on soil organic carbon, crop yields and system profitability**

Crop Yields

(tons/acre)

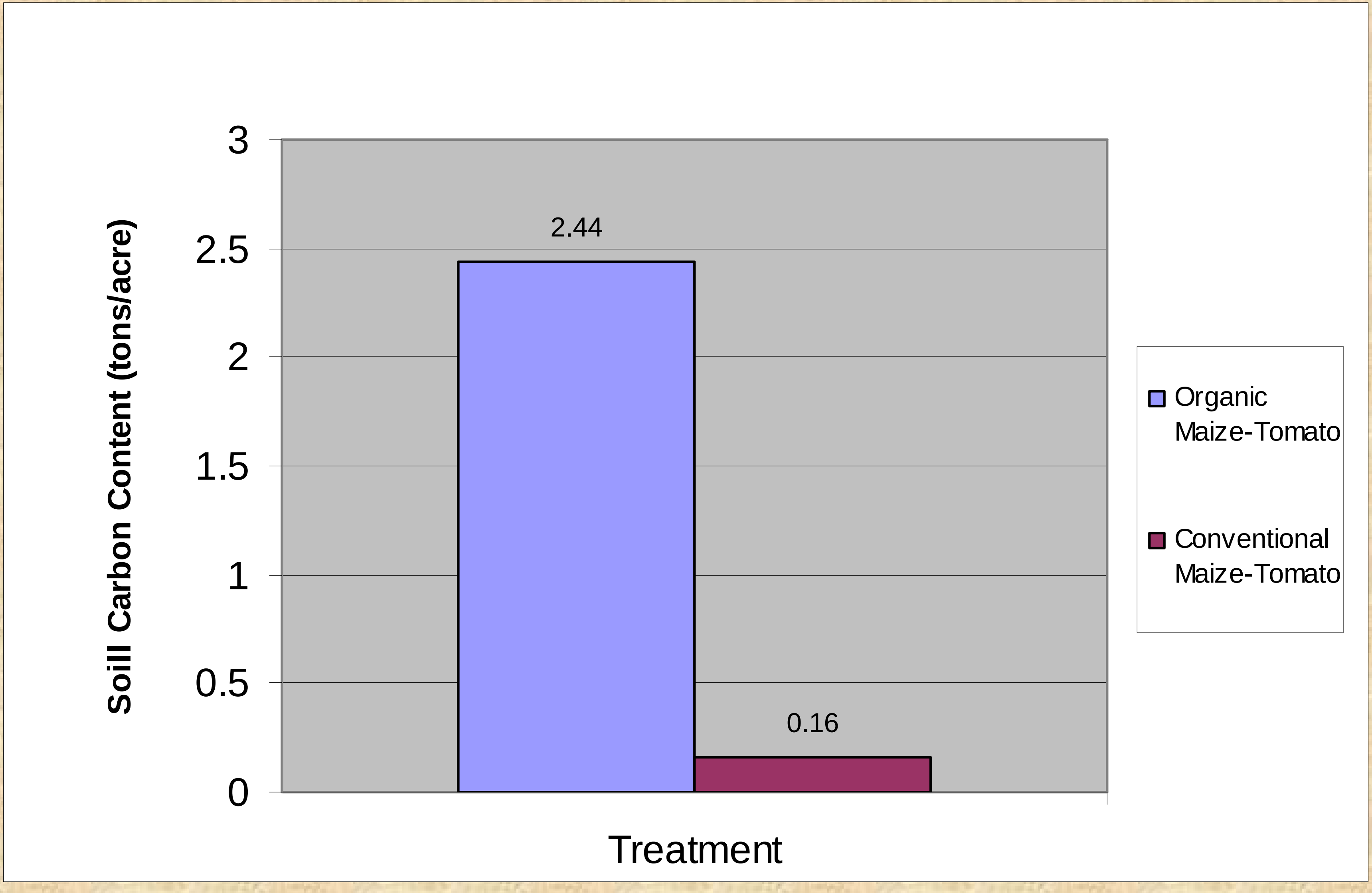
	Year	1	2	3	4	5	6	7	8	9	Avg
Conventional	***maize***	**5.84**		**4.64**		**4.64**		**5.66**		**5.63**	**5.28**
	tomato		**12.97**		**25.15**		**10.46**		**27.54**		**19.03**
Organic	***maize***	**3.98**		**3.02**		**3.87**		**3.29**		**2.39**	**3.31**
	tomato		**31.16**		**26.31**		**30.73**		**32.40**		**30.15**

Profitability

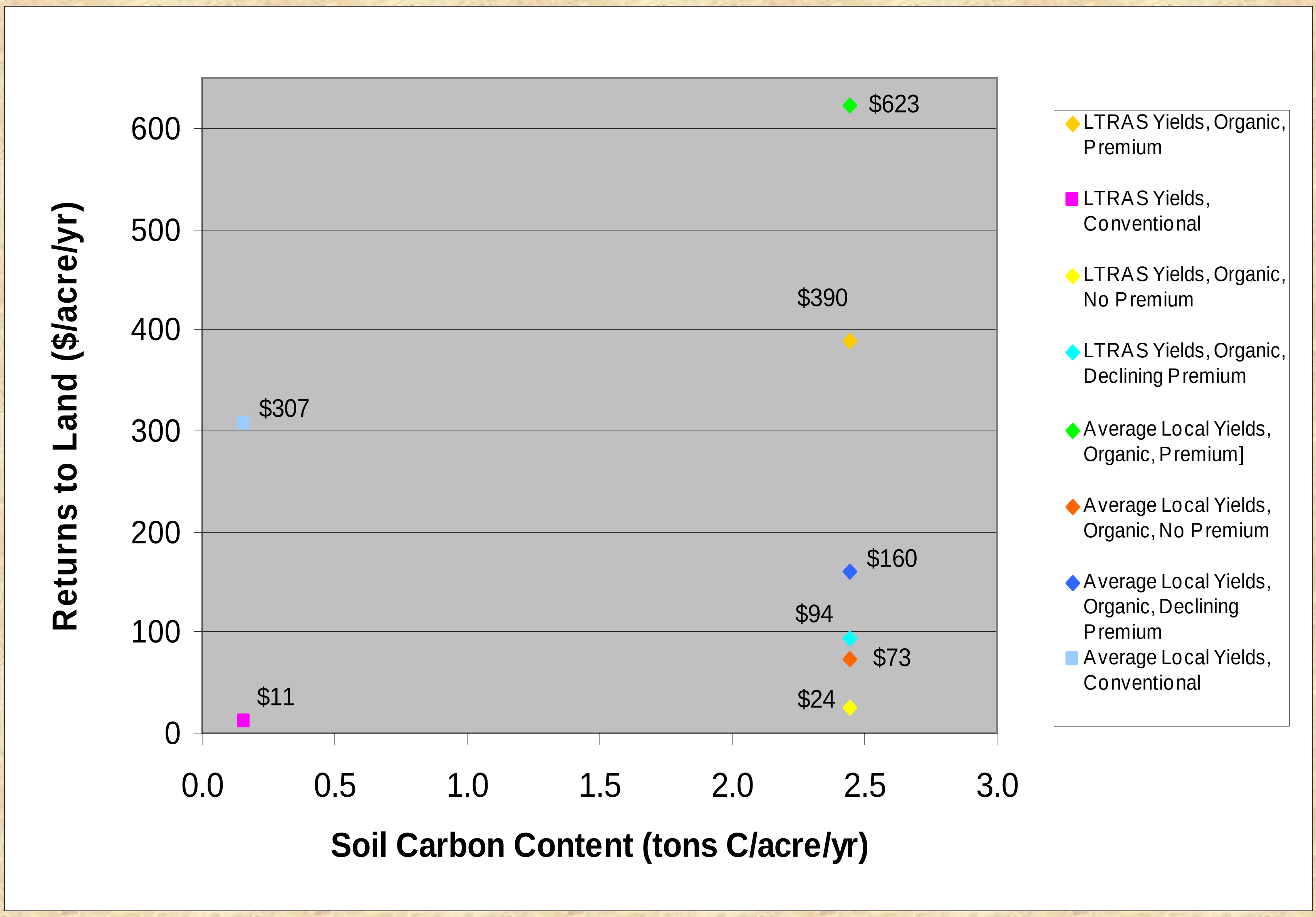
System	Net Present Value ($)	Returns to Land (/$/ac/year)	Profitability as % of Conventional System
Conventional	8278	307	--
Organic, No Premium	1981	73	24%
Organic, Declining Premium	4315	160	52%
Organic, Premium	5607	623	203%

Soil Carbon Accumulation

(over 9 years)



Profitability & Increased Soil C



Case Study Conclusions (Preliminary)

- Stocks of Soil Carbon Can Be Increased in California, but the Amounts Will Depend on:
  - climatic conditions
  - management strategy
  - product mix
  - soil type
- Changes in Product Mix and Crop Management Strategies Can Increase Soil Carbon
  - Such Changes Can Be Costly to Farmers, and Yields and Profits May Decline
- Soil Carbon-Profitability Trade-Offs
  - Field 74 Study Exhibited Trade-Offs
- Soil Carbon-Profitability Synergies
  - LTRAS Tomato/Maize Study Exhibited Synergies
    - These depended greatly on price the premiums

Policy Implications

- Paying Farmers to Sequester Carbon Could Be Expensive
- Payment schemes would have to address local heterogeneity in soil and climate conditions
- Soil Carbon Pools Have Maxima and Sequestered Carbon Can Be Quickly Lost
  - Payment schemes need to take account of this
- Not All Increases in Soil Carbon Are 'Sequestered'
  - Out-of-system inputs can matter greatly
  - Perhaps these 'imports' should also be paid for under incentive schemes

Implications for Research

- We Need to Know Much More About Carbon Dynamics in California Soils
  - Product mixes
  - Soil management practices
  - Soil types
  - Limits to and stability of carbon pools
- We Need to Know More About the Effects of Different Tillage and Residue Management Strategies on:
  - Yields
  - Production costs
  - Risk
  - Profits

Contracts for Soil Carbon Sequestration

- **Standard Contracts**
- **Modifying Contracts to Meet the Needs of California Farmers**
  - **Duration**
  - **Up-Front costs**
  - **Escrow accounts**
  - **Monitoring**
  - **Within-contract changes in**
    - **Product mix**
    - **Production technology**

- **THANKS!**

- **WHAT ARE YOUR VIEWS?**