

Calculating the Carbon Footprint of Florida Orange Juice

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CO₂ Concentrations in Earth's Atmosphere are Rising Rapidly

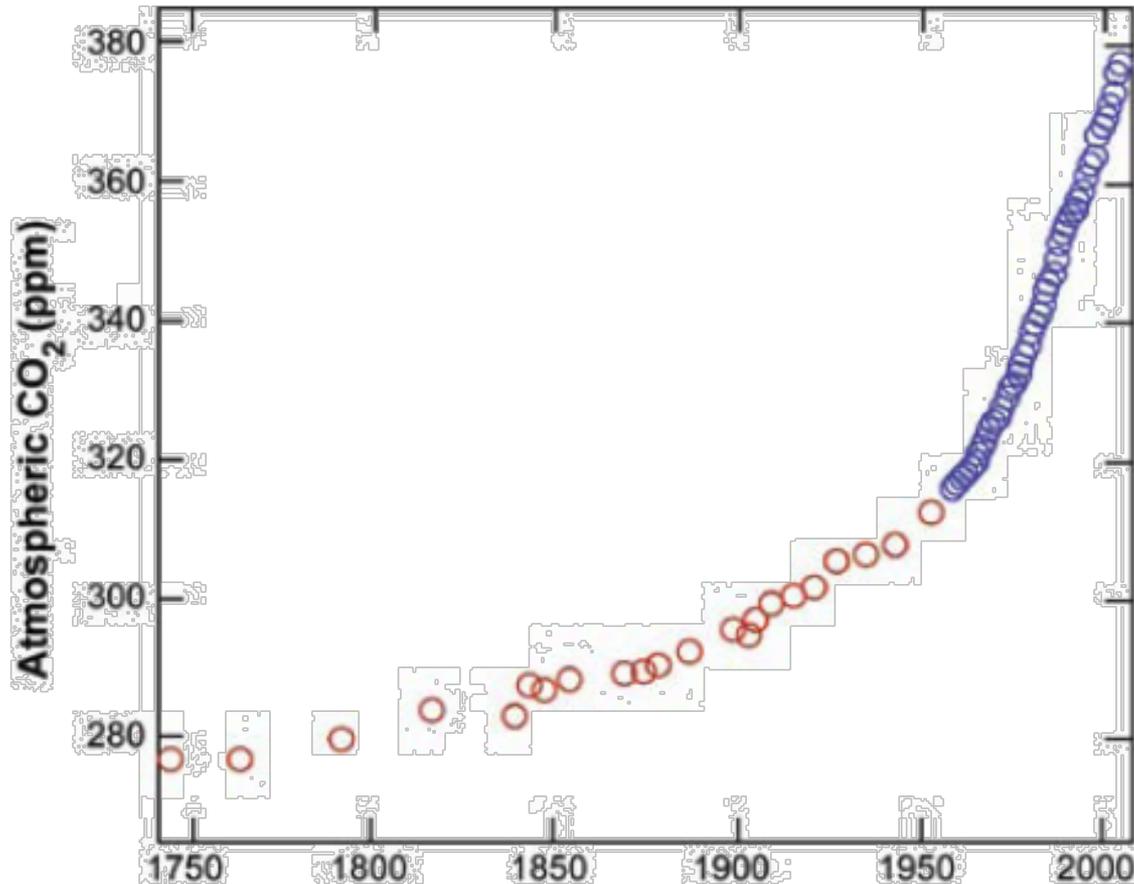


Figure 2.2 Atmospheric CO₂ concentration from 1750 to 2005. The data prior to 1957 (red circles) are from the Siple ice core (Friedli et al., 1986). The data since 1957 (blue circles) are from continuous atmospheric sampling at the Mauna Loa Observatory (Hawaii) (Keeling et al., 1976; Thoning et al., 1989) (with updates available at <http://cdiac.ornl.gov/trends/co2/sio-mlo.htm>).

<= 350 ppm is level deemed sustainable (Hansen, NASA)

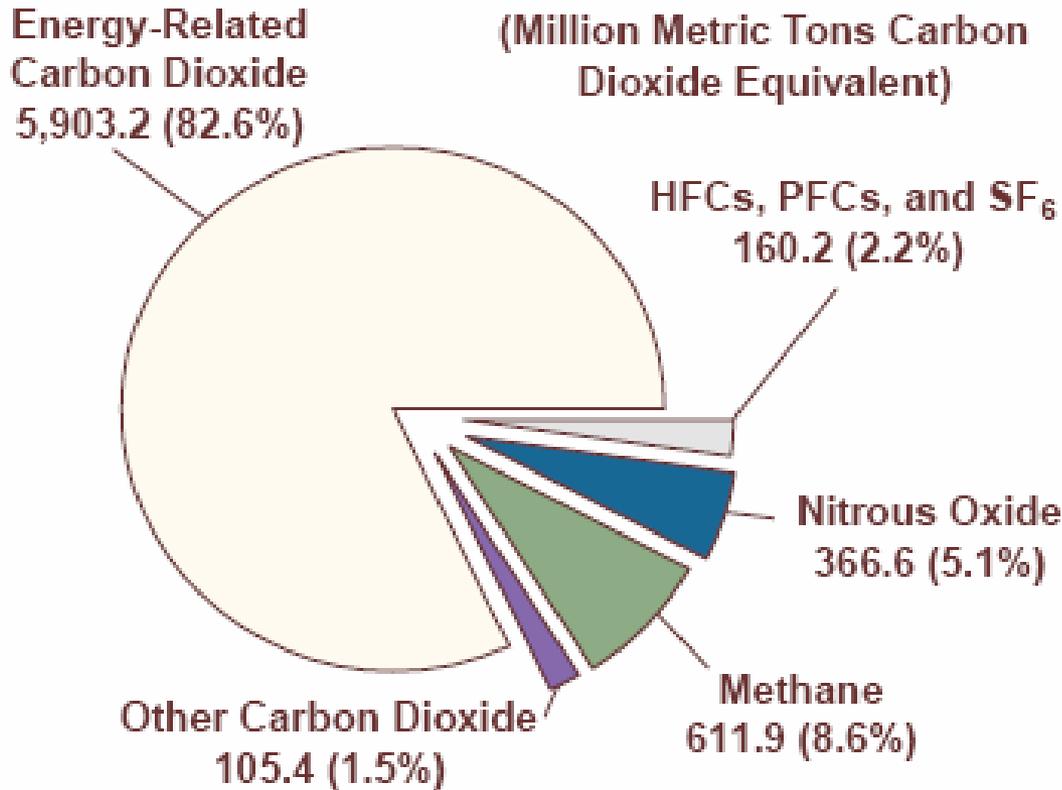
Global Warming Potential (GWP) of Greenhouse Gases

Gas	100 Year GWP
Carbon dioxide (CO ₂)	1
Methane (CH ₄)	21
Nitrous oxide (N ₂ O)	310
Hydrofluorocarbons (HFCs)	150-11,700
Perfluorocarbons (PFCs)	6,500-9,200
Sulphur hexafluoride (SF ₆)	23,900

1 ton carbon = 3.66 tons CO₂ equivalent

Greenhouse Gas Emissions in the US

Figure ES1. U.S. Greenhouse Gas Emissions by Gas, 2005



Source: U.S. Department of Energy-Energy Information Administration, 2006. Emissions of Greenhouse Gases in the United States 2005.

Figure ES3. U.S. Carbon Dioxide Emissions from Energy Use by Sector, 1990-2005

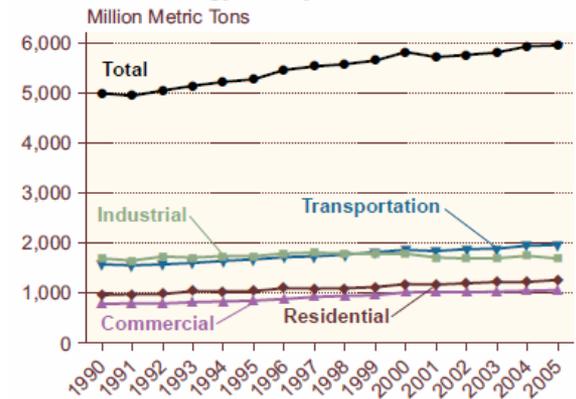


Figure ES4. U.S. Emissions of Methane by Source, 1990-2005

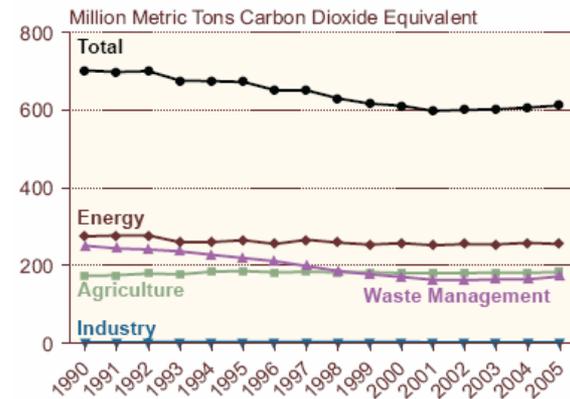
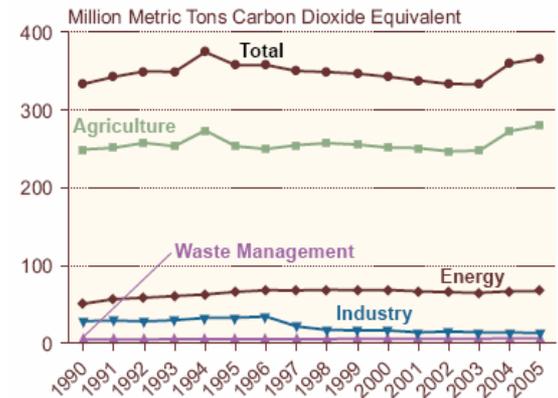


Figure ES5. U.S. Emissions of Nitrous Oxide by Source, 1990-2005



Policy Environment for Greenhouse Gas Control

- Follows from success of cap-and-trade for sulfur-dioxide emissions in U.S. (1970s).
- Kyoto protocol set declining cap on emissions referenced to 1990 levels.
- European Union established emission allowances for each country.
- Clean Development Mechanism (CDM) established trading platform in 2006.
- Voluntary offset trading in US, Australia.
- Various state-level policies in the U.S.
- Reducing Emissions from Deforestation and Degradation (REDD) for developing countries.
- Copenhagen summit in Dec. 2009 discussed the next generation greenhouse gas treaty with the U.S. and China both making verbal commitments.
- Anticipate regulation-driven markets from cap-and-trade legislation in the U.S.

U.S. Carbon Markets

- Chicago Climate Exchange (CCX)
- Regional (Northeast) Greenhouse Gas Initiative (RGGI)
- California Climate Action Reserve (CCAR)



Florida OJ Production and Carbon

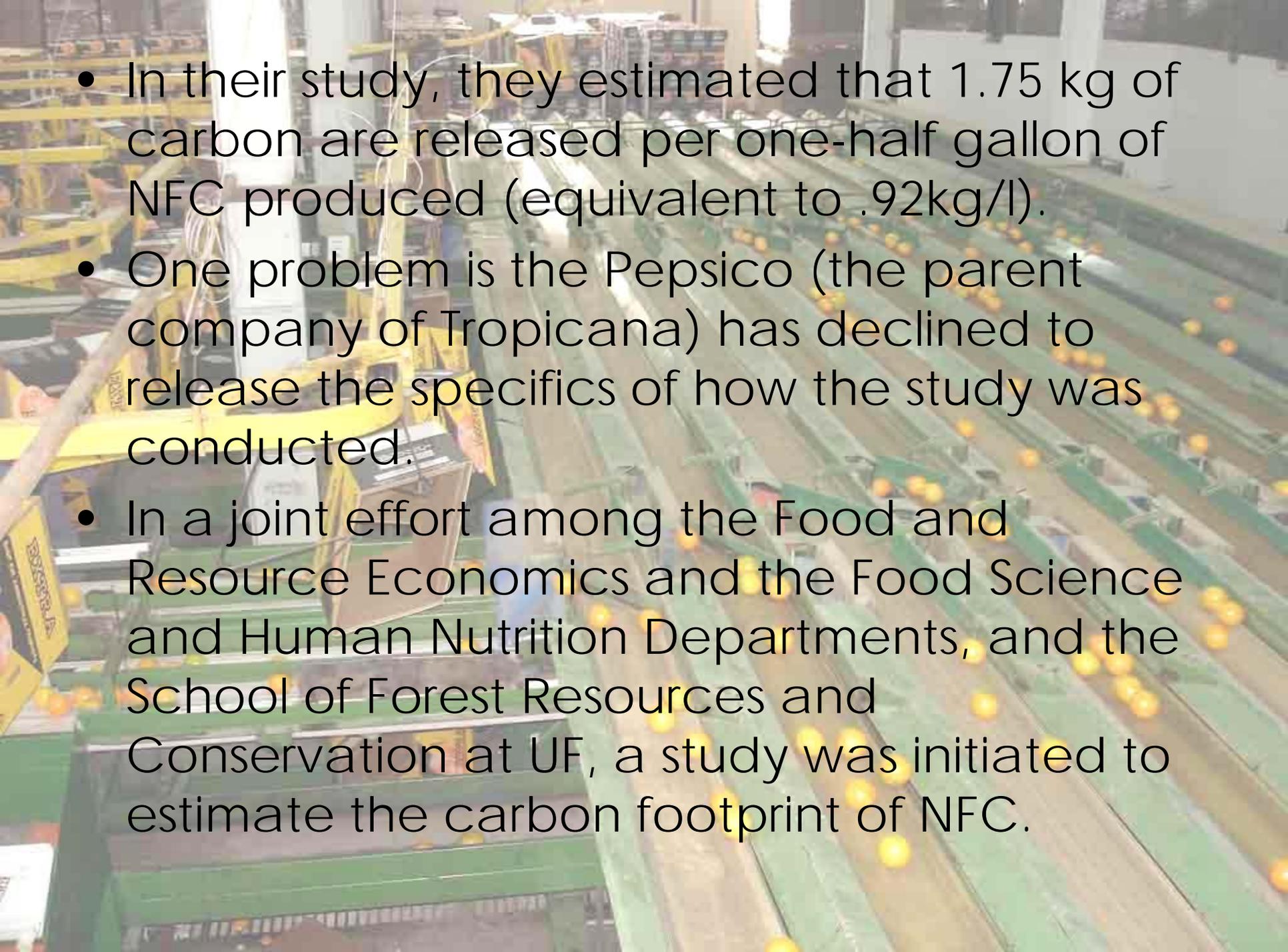
- U.S. agricultural interests have been vocal in their opposition to cap-and-trade even though some landowners would realize a new source of income if cap-and-trade becomes law.
- What are the net carbon emissions associated with Florida orange juice production, packaging, and distribution?
- It is important to differentiate between not-from-concentrate (NFC) and from concentrate (FCOJ).
- Tropicana conducted its own estimation of the carbon footprint of its Tropicana Pure Premium which was released Spring of 2009.

Tropicana Carbon Footprint Estimate for NFC OJ

1.75kg per 64oz.

growing the oranges 60%
Transportation 22%
Packaging 15%
Disposal 3%

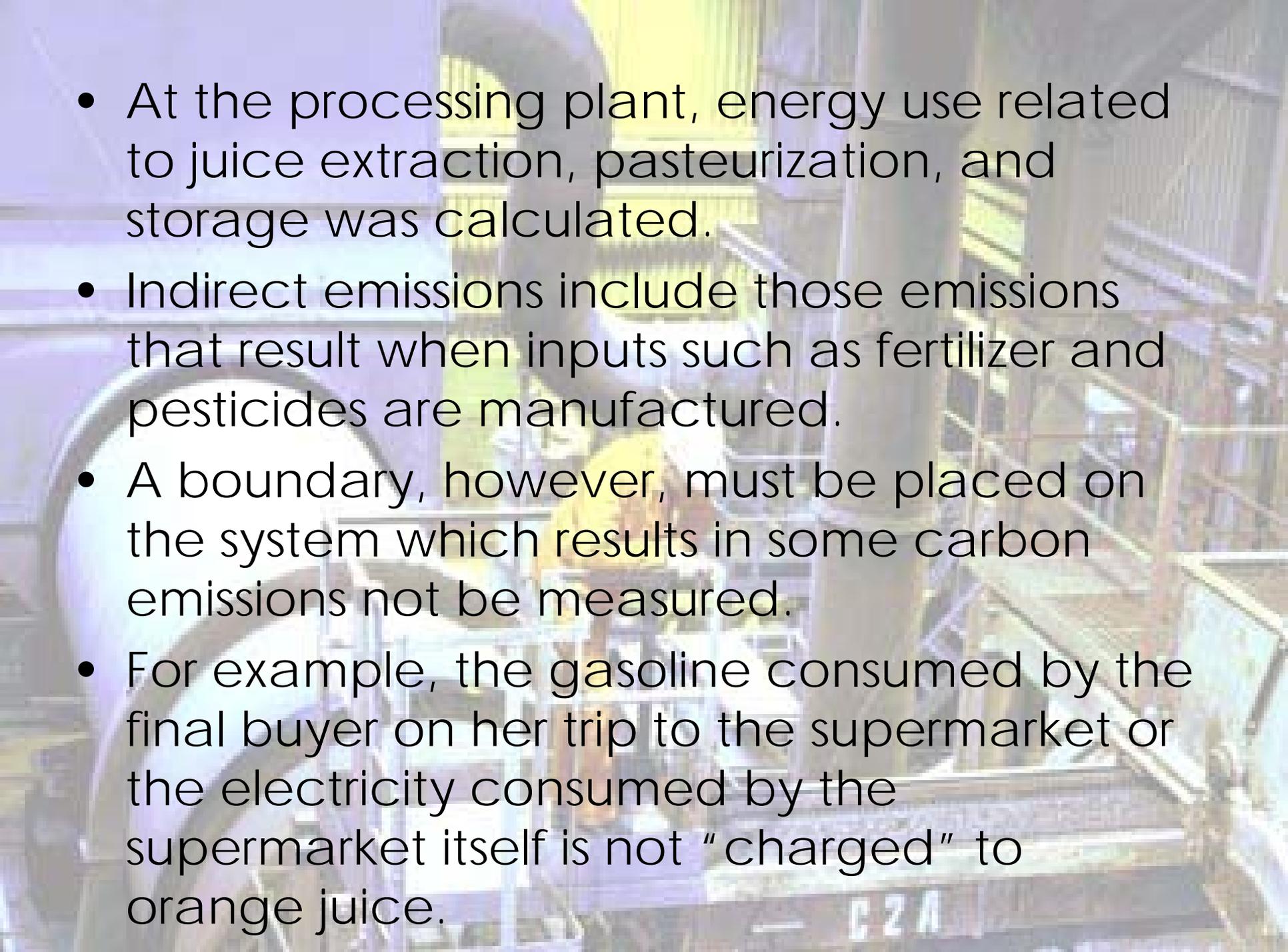


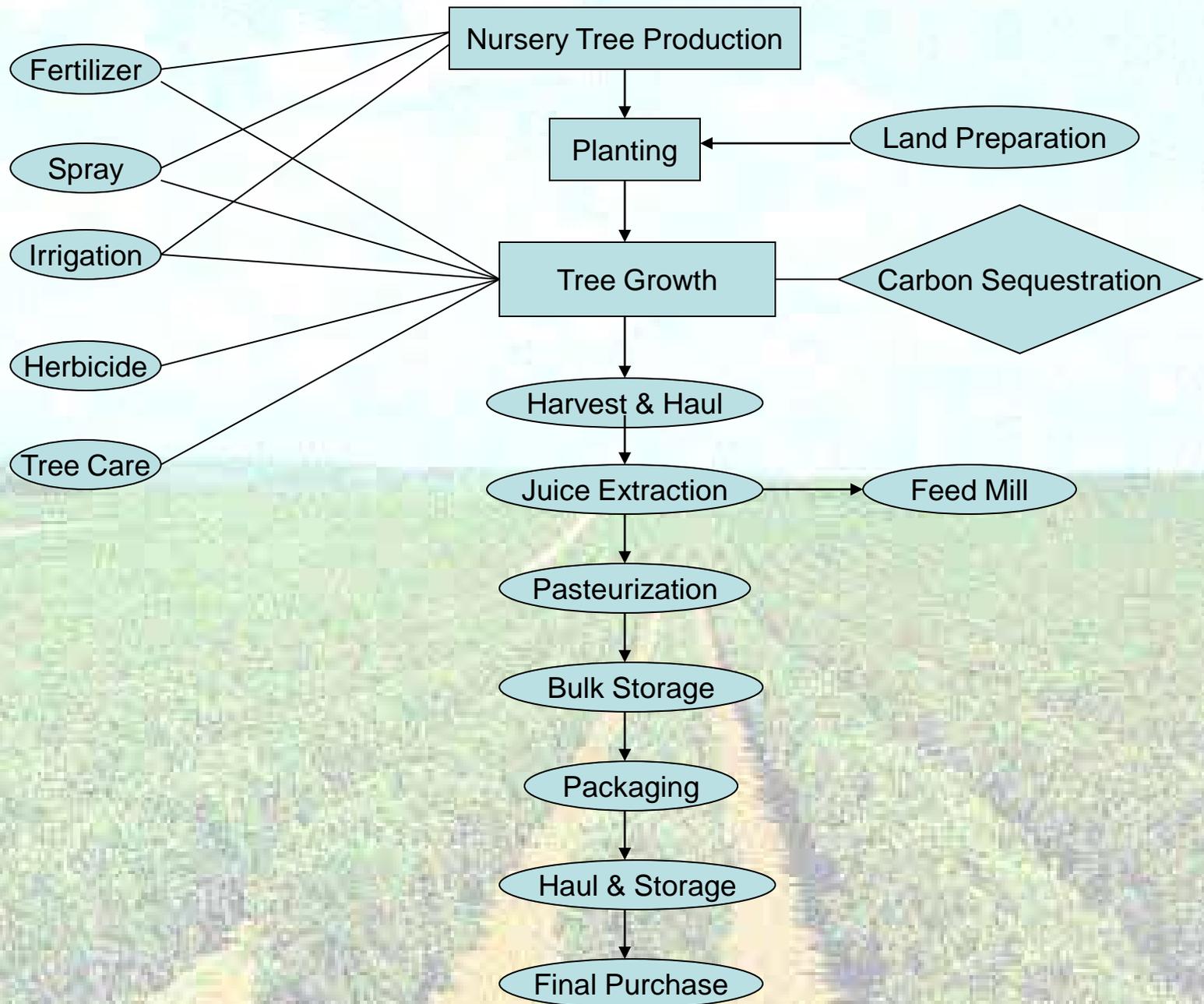
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- In their study, they estimated that 1.75 kg of carbon are released per one-half gallon of NFC produced (equivalent to .92kg/l).
 - One problem is the Pepsico (the parent company of Tropicana) has declined to release the specifics of how the study was conducted.
 - In a joint effort among the Food and Resource Economics and the Food Science and Human Nutrition Departments, and the School of Forest Resources and Conservation at UF, a study was initiated to estimate the carbon footprint of NFC.

Procedure

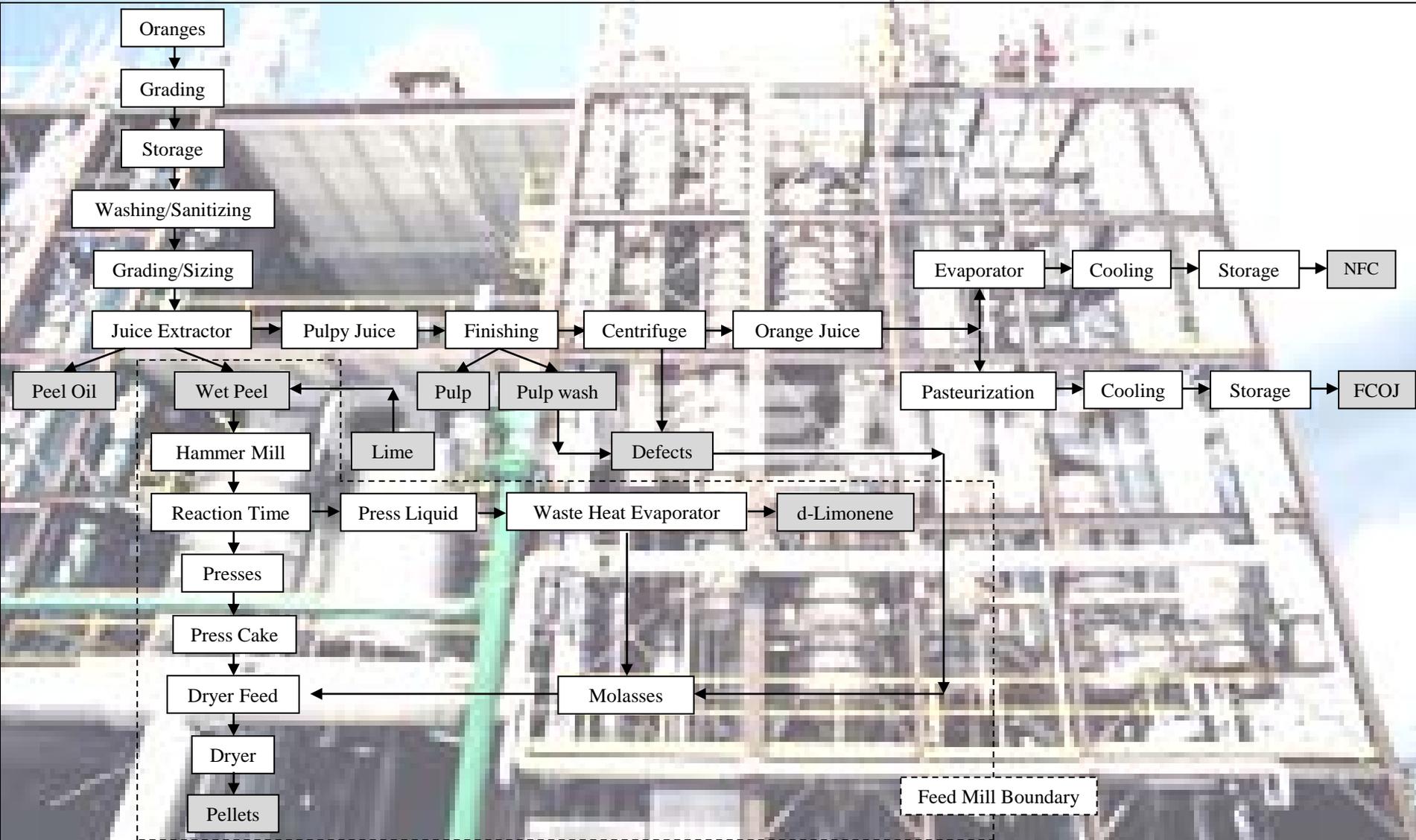
- Tree nursery operators, grove care management operations, and citrus processors were contacted.
- Tree nursery operators were asked to provide inputs used per nursery tree produced. Inputs include fertilizer, spray, irrigation, and the medium used for the young tree.
- Groves are assumed to be planted at 150 trees per acre and have an expected life of 30 years.

- Fruit and juice yields are taken from the *Citrus Summary*, an annual publication produced jointly by the United States Department of Agriculture and the Florida Department of Agriculture.
- Input use is based upon the reports published annually by Muraro, et al. from the University of Florida.
- Carbon emissions measured include both direct and indirect. Direct emissions are those from tractors, trucks, and other petroleum powered equipment as well as diesel powered wells for irrigation.

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- At the processing plant, energy use related to juice extraction, pasteurization, and storage was calculated.
 - Indirect emissions include those emissions that result when inputs such as fertilizer and pesticides are manufactured.
 - A boundary, however, must be placed on the system which results in some carbon emissions not be measured.
 - For example, the gasoline consumed by the final buyer on her trip to the supermarket or the electricity consumed by the supermarket itself is not "charged" to orange juice.



Process diagram of a citrus processing mill



Carbon Dioxide and Carbon Emissions in the Florida NFC Production and Marketing Chain

	gCO ₂ /Half Gal.	gC/Half Gal.
Site Prep	2.95	0.80
Grove Maintenance	1378.14	375.86
Harvest and Haul	39.84	10.87
Juice Extraction, Pasteurization, and Storage	518.80	141.49
Packaging	90.44	24.67
Transport to Retail	40.21	10.97
Storage at Retail	303.95	82.90
Total	2374.33	647.54

Concluding Remarks

- Carbon emissions and carbon footprint calculations are becoming important topics.
- A study of the carbon footprint of NFC orange juice has been initiated by UF.
- Our first set of results suggest that .725 kg of carbon is emitted by one-half gallon of orange juice in the growing, harvesting, and transport phases. This number is substantially lower than the 1.05 kg estimated by Tropicana.