# Energy Crops in California
# Setting the Stage

**California Energy Commission**

**Biofuels Workshop**

**2009 Integrated Energy Policy Report**

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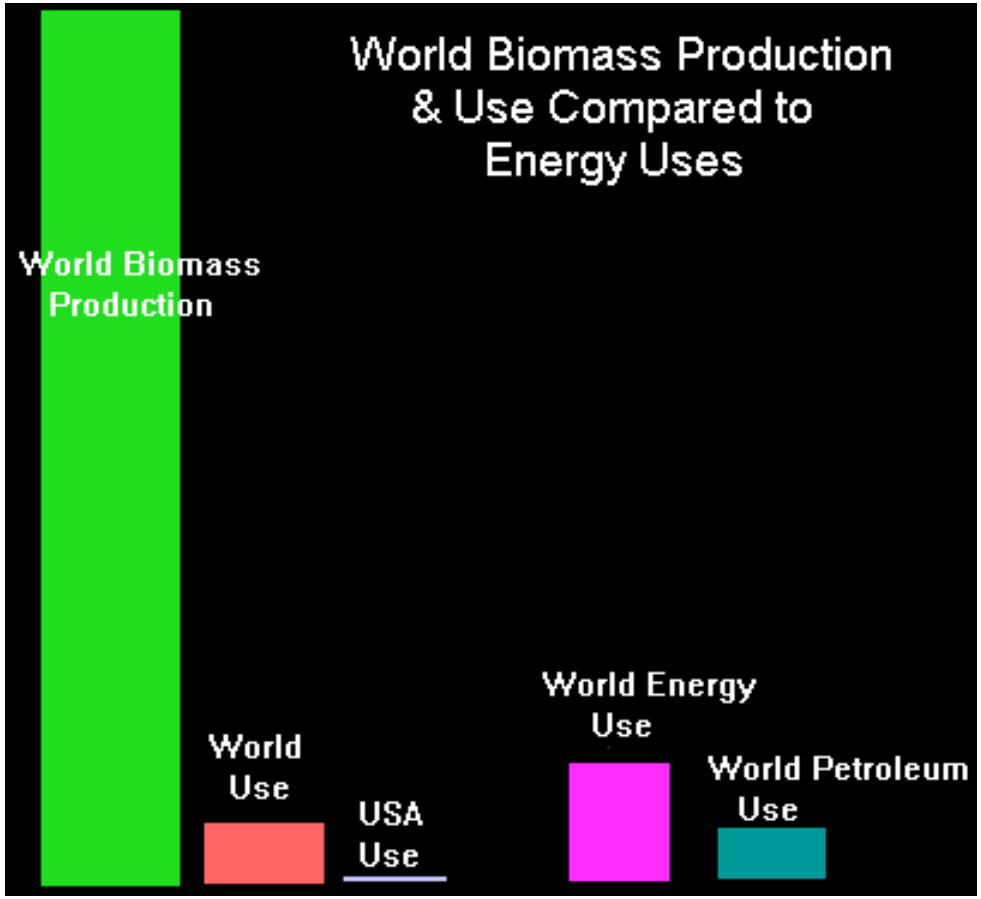
# Overview

- Why not Energysheds?
- Natural resources trends
  - Issues – opportunities and challenge
- Examples
  - Klamath; Sac Valley; Delta; Central Coast; Westside; Tulare; Imperial Valley
- Summary and conclusions

# The Concept

- Watersheds; Airsheds; Foodsheds
- Energysheds!
- Interconnectedness
- Multiple Objectives
- Local self-reliance
- Collaboration

# Biomass Energy Potential



# Feedstock Quantity

- USDA/DOE – 1.3 billion tons/years – optimistic?
  - http://www.osti.gov/bridge/product.biblio.jsp?osti_id=885984 Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasability of a Billion-Ton Annual Supply Perlack, R.D. ORNL/TM-2005/66 ; 2005 Dec 15
- California – Biomass Collaborative
  - http://biomass.ucdavis.edu/
  - Over 80 million tons produced (no energy crops)
  - Potential sustainable use - 30 million tons
  - By 2050 - 48 million tons
  - Current use – 5 million tons

# Biomass Energy Potential

- 1.3 billion tons of biomass =
  - 50 billion to 100 billion gallons of liquid fuel (gallons of gasoline equivalent – gge)
- Current US gasoline and diesel consumption: 180 billion gallons
- 30 million tons = 1.5 billion to 3 billion gge

# Fuels

- Alcohols – ethanol, methanol, butanol, etc.
- Ethers – MTBE, ETBE, TAME, DME
- Biodiesel – esterified plant and animal fats
- Bio-derived oils – hydrocarbons – bio-oil (algae; bioengineered microbes), Fischer-Tropsch diesel.
- Biomethane – purified biogas.
- Electricity – combustion, gasification, fuel cell.
- Hydrogen – secondary product reformed from above, or primary production e.g. from algae.

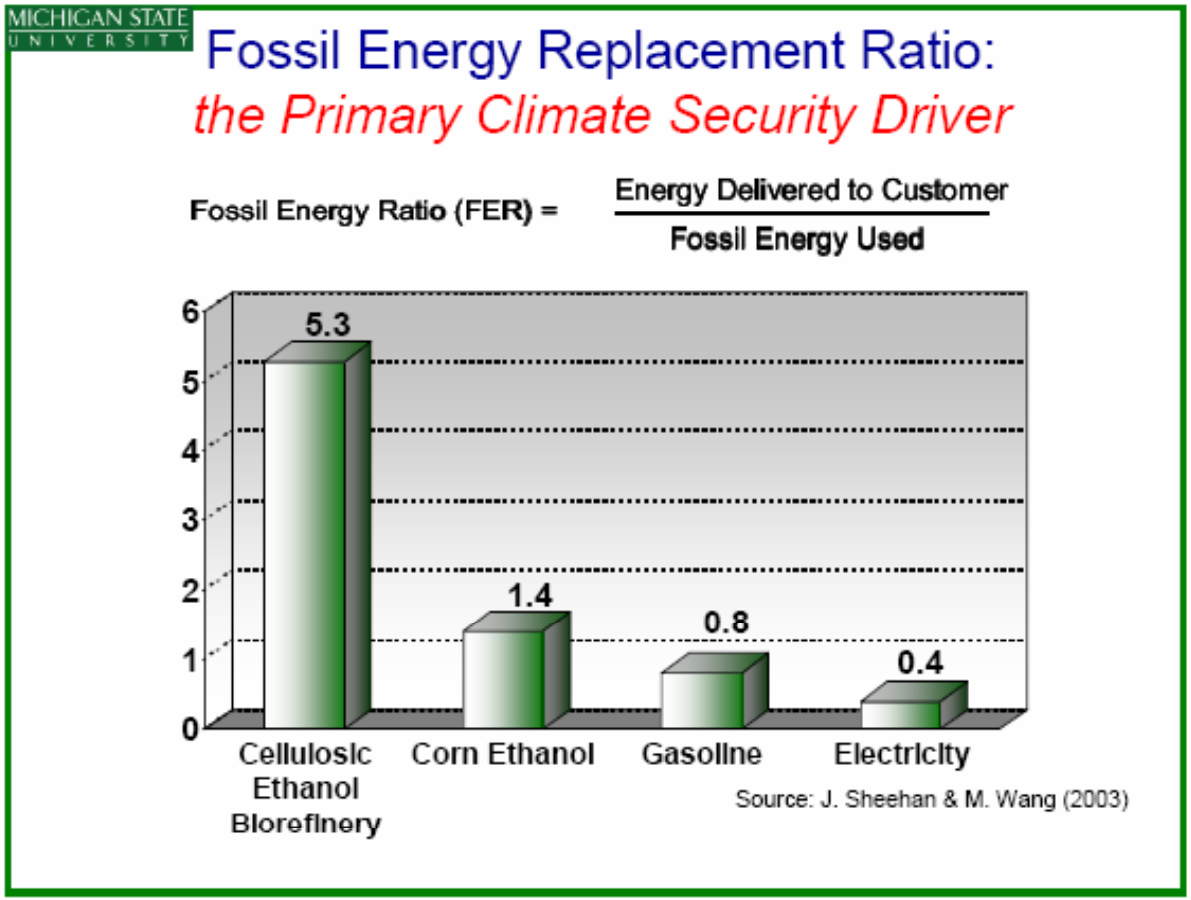
# Potential “Energy Crops”

- Agricultural Residuals
  - Manure, trees and vines, straws, food processing residuals, animal materials
- Conventional crops – corn, sorghum, sugar cane, sugar beets, oil seeds (safflower, sunflower, canola, etc.) other small grains.
- Dedicated crops – grasses, trees, other plants
- Unconventional crops – Jerusalem artichoke, Buffalo gourd, Cattails, Jatropha, Jojoba, Salicornia, Algae???

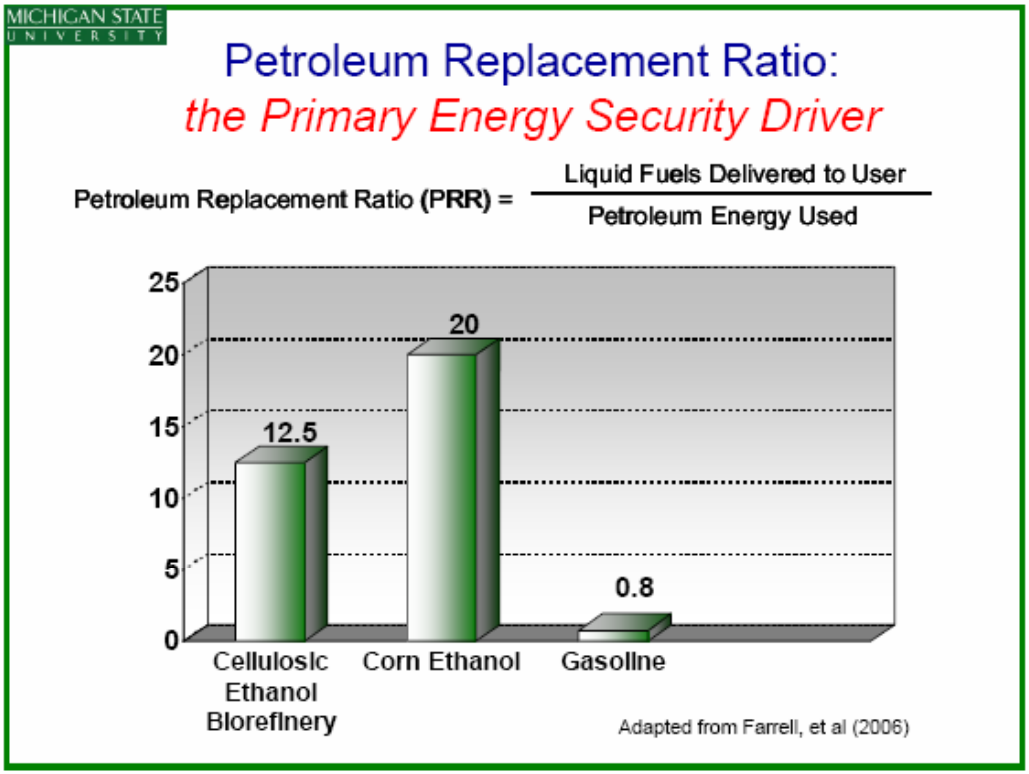
# Issues – (Sustainability)

- Life cycle analyses
- Energy quality/utility
- Resource intensity - land and water use
- Multiple objectives management
- Geopolitics – energy security
- Climate change
- (Bio) technology
- End use technology
- Economic

# Energy Efficiency



# Petroleum Replacement Efficiency



# Energyshed Examples

- Sugar beets and sweet sorghum, vegetation management in the Klamath Basin?
- Habitat corridors and rice straw in the Sacramento Valley?
- Reinventing Delta agriculture?
- Rotational crops in high value systems?
- San Joaquin Valley opportunities with dairies and drainage impaired lands?
- Sugar cane production and processing in Imperial Valley?

# On-farm Considerations

- Resource availability
- Economies of scale
- Integration into existing operation
- Ability to manage
- Regional opportunities – coops; JPAs.
- Not only biomass – PV, solar thermal, small hydro, wind, geothermal, etc.

# Conclusions

- Biofuels are and will be a part of sustainable energy supplies – how much and in what form are yet to be determined.  A Polyfuel Future.
- It can be done well, or it can be done poorly.
  - Several Keys –
    - Informed policy based on continuous research and development
    - Strategies that achieve multiple benefits
    - Public policies that recognize multiple benefits and internalize external disbenefits for all energy sources