

# Algal Biofuels

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Wikipedia

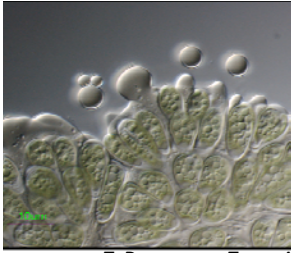


## U.S. Energy Security Depends on Transportation Fuels

- The US has 230 million automobiles and uses 25% of the world's oil (~20 M barrels/day)
- Dependence on foreign oil will likely increase 30% by 2030
- **Current total US petroleum based fuels consumption is**
  - **~20 M barrels/day = 300 B gallons/year**
- Our **energy security** relies on our ability to find alternative fuels
- Current U.S. goal is to increase supply of renewable fuels
  - 36 billion gallons/year by 2022
  - Cost of no more than \$1.20/gallon

## New Mexico is Contributing to the Solution

- LANL, NMSU and several companies are currently making significant contributions to national renewable fuels research
  - Generation 3 & 4 fuel production “from algae to fuels”



T. Devarenne, Texas A&M

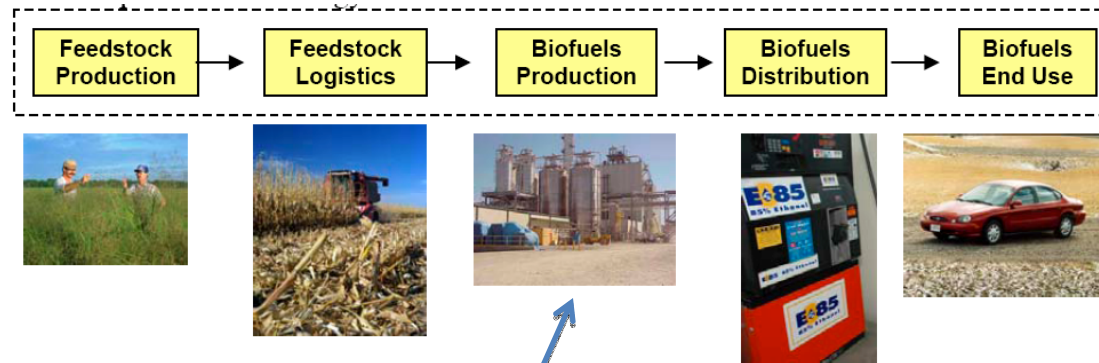
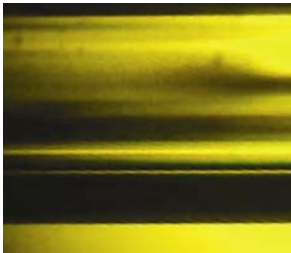
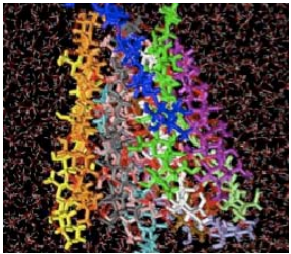
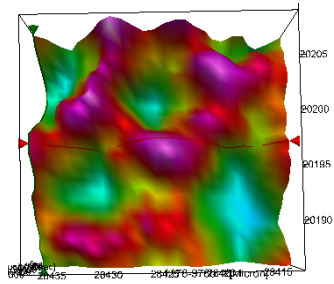
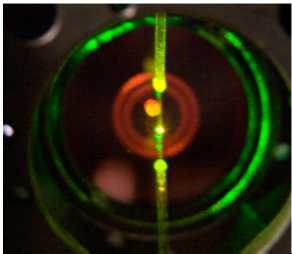


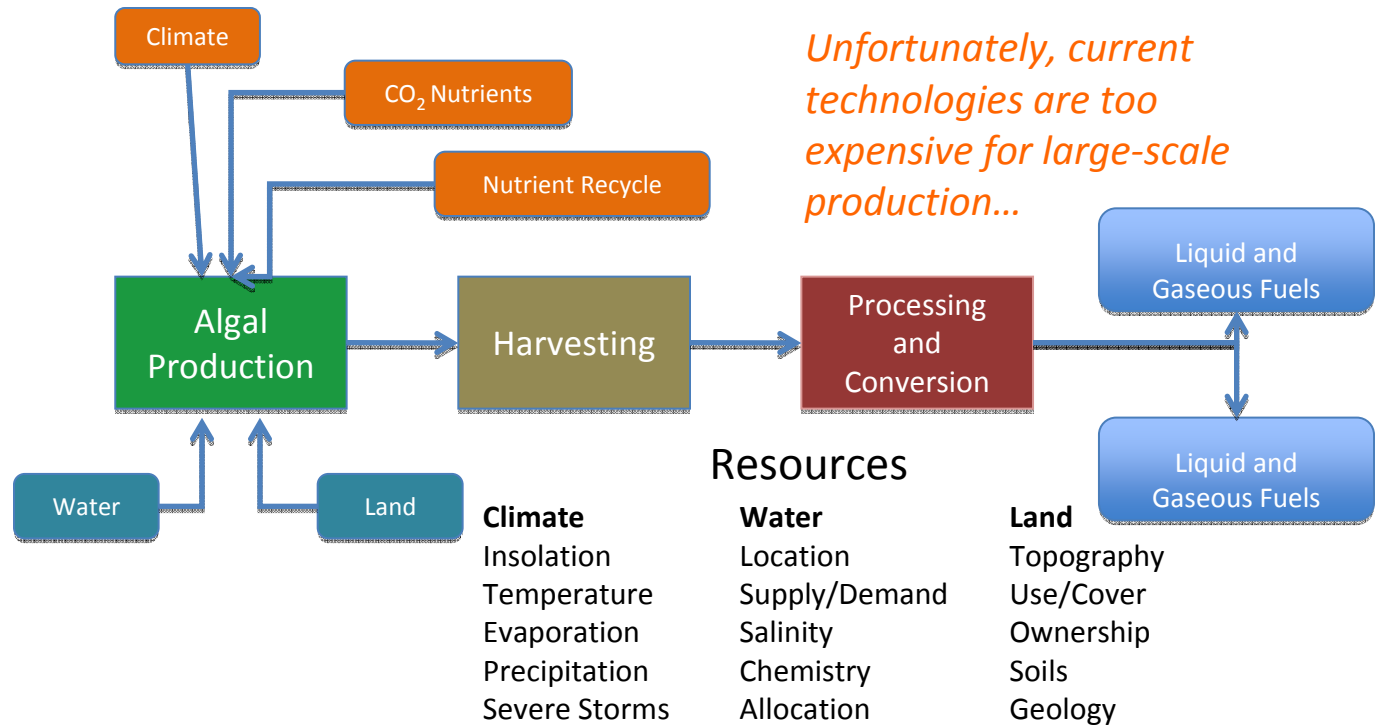
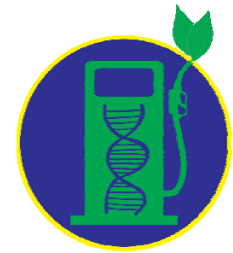
Figure 3: Microalgal production raceway in southeast New Mexico. Courtesy of the CEHMM, Carlsbad, NM, [www.cehmm.org](http://www.cehmm.org)

*Biomass Multi-Year Program Plan, US DOE Office of Biomass Programs, March 2008*

# Algae: *The Solution* for Transportation Fuel



- **No competition for agricultural resources**
  - Can grow in arid land environments
  - Thrive on brackish water
- **Flourish in the sun**
- **Utilize CO<sub>2</sub>**
- **Highest photosynthetic rate of all biofuel plants**
- **Can produce higher energy density fuels**





# Land Use for Fuels

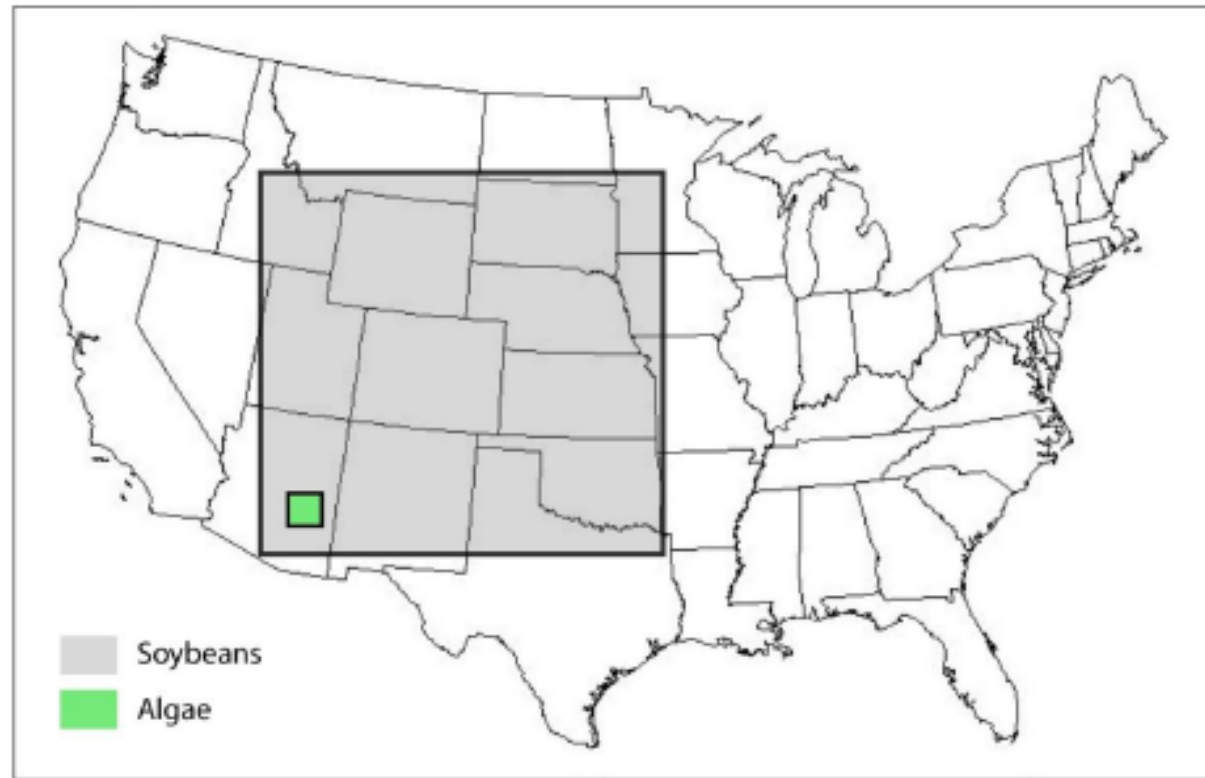
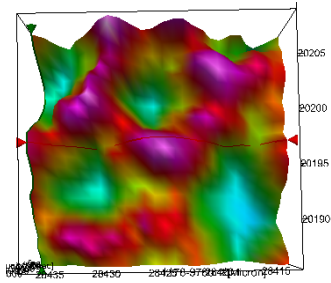
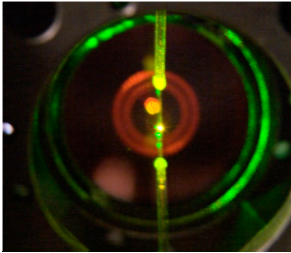
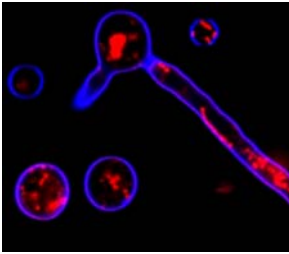
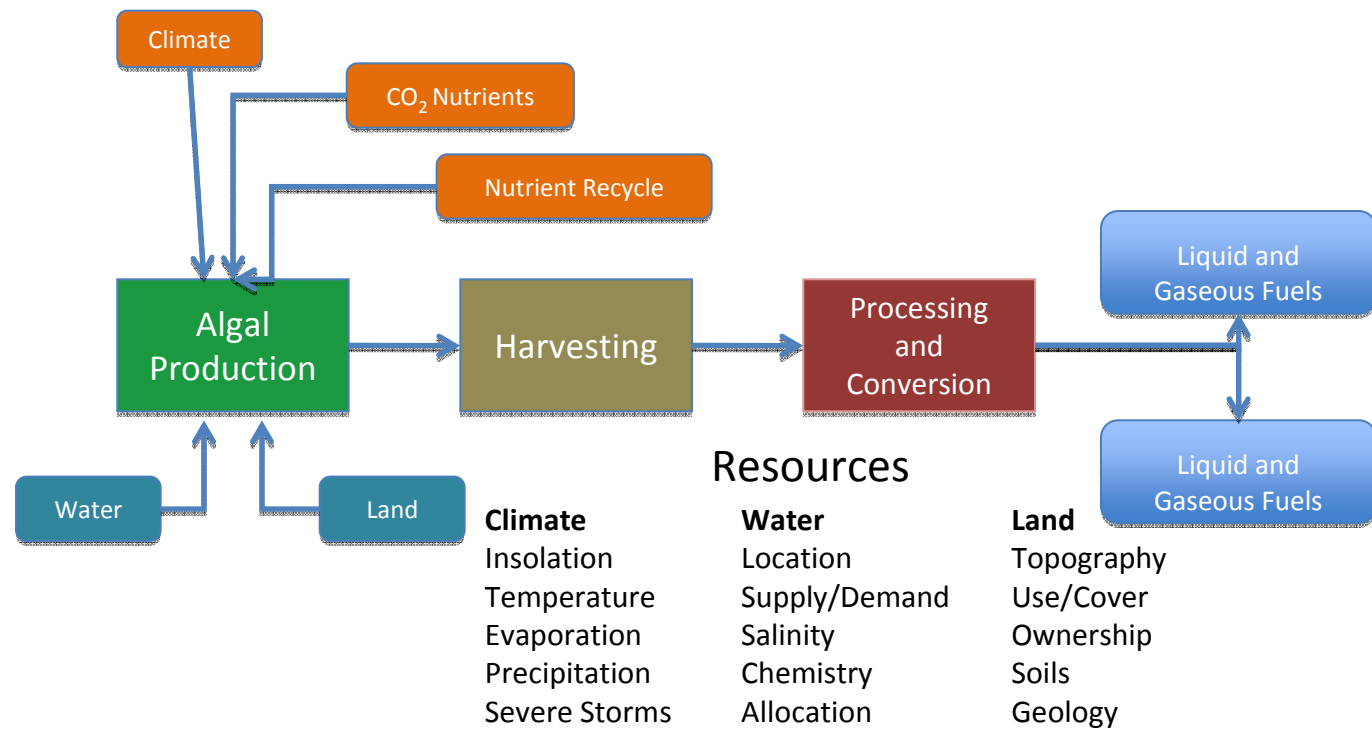


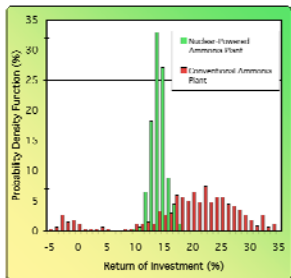
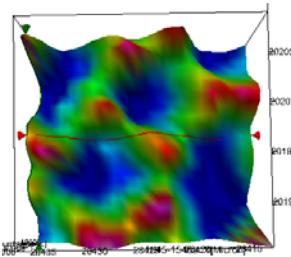
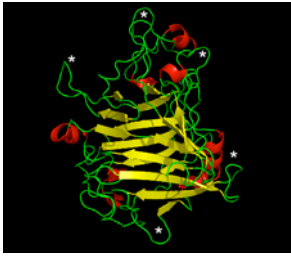
Figure 9-4. Land requirement. The amount of land required to replace 50% of the current petroleum distillate consumption using soybean (gray) and algae (green). Adapted from Bryan, et.al. (2008)



# Making Algal Fuels a Reality



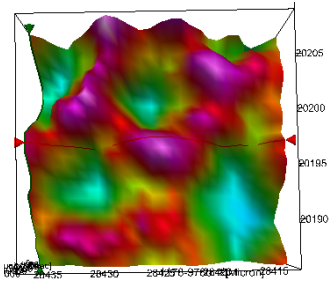
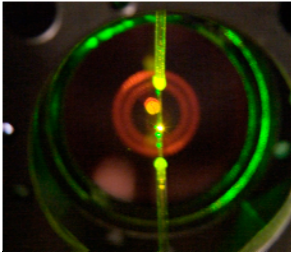
- **High biomass productivity algal strains**
- **High lipid/hydrocarbon yields**
- **Efficient cultivation methods**
- **Efficient harvesting methods**
- **Efficient methods for conversion to fuels**
- **Establish markets for coproducts and byproducts**



## NM Research & Development is Making a Difference

- Innovative algal growth enhancement strategies to *reduce feedstock cost*
- Novel techniques for algae separation and lipid extraction to *reduce production cost*
- Engineering technologies to *extrapolate to industrial scale production*
  - *Fuel conversion technologies*
- Agronomic analysis to *optimize production processes* –
  - *Land-Water utilization*
  - *Resource management*
- Agriculture expertise to *maximize potential of production co-products*
  - *Animal feed testing and development*

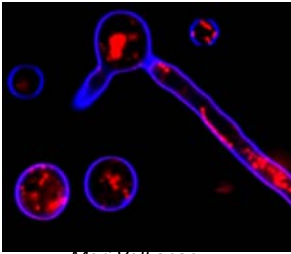
## NM Research & Development is Making a Difference



- **Biofuel-ready Technologies from LANL**
  - TakeOff for growth enhancement
  - Acoustic focusing for algae harvesting and lipid separation
  - Enzyme engineering for fuel conversion strategies
  - Low-temperature catalysis for fuel conversion
- Industrial Investment with over \$3 M from 7 CRADAs
- **Agronomic Research & Development at NMSU**
  - Open pond cultivation technologies
  - Supercritical fuel conversion technologies
  - Sustainability practices
- **Test-bed Sites and Fuel Production at State Industries**
  - CEHMM – Artesia NM
  - Eldorado Biofuels - Waste/brackish water usage
  - SAPPHIRE –Las Cruces NM



## An Opportunity for New Mexico



Mari Valkonen,  
VTT Technical Research Center



Solix Biofuels



Wikipedia



- **Climate, ecology, resources conducive to algae growth**
- **New direction for the wealth of expertise at**
  - **National Laboratories: LANL, SNL**
  - **Academia: NMSU, UNM, NM Tech**
- **Regional Jobs and Economic Development**  
(The San Diego Association of Governments)
  - **\$100 M in Venture Funding =**
    - **100 employees**
    - **\$7.75 M in payroll / yr**
    - **\$15 M in economic activity**
    - **Secondary economic activity**
      - **110 employees**
      - **\$14 M in economic activity**
      - **\$4.1 M in payroll /yr**



Courtesy of Solix Biofuels

## Our Vision is a National Coalition for Algal Biofuels

- **A leading coalition would have:**
  - **Regional solutions:** - *Land, water, and sun*
  - **Partnerships:**
    - **National Laboratories-** *Research and technology*
    - **Academia:** *Research, technology, and a skilled workforce*
    - **Industry:** *Commercialization focus*
  - **Community Support:** *State Governments, Local/Regional Entities*
- **National Alliance for Advanced Biofuels and Bioproducts (NAABB)**

