Density of Annual Alcohol and Co-Product Shipments by Rail, 2006
Status of Unit Train Destinations, December 2009

Advanced Biofuel Production by Region Mandated by RFS2 (USDA/2010)

<table>
<thead>
<tr>
<th>Region</th>
<th>Advanced biofuels (bg/y)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% of total</td>
<td>EtOH</td>
</tr>
<tr>
<td>Southeast</td>
<td>49.8</td>
<td>10.45</td>
</tr>
<tr>
<td>Central east</td>
<td>43.3</td>
<td>8.83</td>
</tr>
<tr>
<td>Northeast</td>
<td>2.0</td>
<td>0.42</td>
</tr>
<tr>
<td>Northwest</td>
<td>4.6</td>
<td>0.79</td>
</tr>
<tr>
<td>West</td>
<td>&lt;0.3</td>
<td>0.06</td>
</tr>
<tr>
<td>US</td>
<td>20.6</td>
<td>0.45</td>
</tr>
</tbody>
</table>

SE: per. grasses, soybean, logging residues, other biomass crops; CE: per. grasses, corn stover, soybean, logging residues; NE: per. grasses, corn stover, soybean, logging residues; NW: straw, canola, logging residues; W: logging residues, sweet sorghum
1. Assumed capacity factors are 20% for residential and commercial solar PV and 90% for biopower.

Koyama, CEC, 2009
Opportunities for biofuel feedstock production in California’s agricultural systems exist, but are overlooked from a national perspective.

Canola grown as bee pasture in young pistachio orchard, Kern County_2010
EPA Tracked Sites with Biorefinery Facility Siting Potential

This map was developed by SRA International for the US Environmental Protection Agency (EPA) OSWER Center for Program Analysis. Results are based on site screening criteria adapted from National Renewable Energy Laboratory (NREL) criteria and GIS data provided by NREL and EPA. This map and its associated data are intended to provide a general understanding of the renewable energy potential of EPA tracked sites; additional site-specific technical and economic analysis is required to determine the actual energy generation potential of EPA tracked sites. For further information, please see the accompanying Data Guidelines document at www.epa.gov/renewableenergyland or contact cleanenergy@epa.gov.

Biomass Resource

<table>
<thead>
<tr>
<th>Metric Tons/Year</th>
<th>Resource Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50,000</td>
<td>Low</td>
</tr>
<tr>
<td>50,000 - 100,000</td>
<td>Marginal</td>
</tr>
<tr>
<td>100,000 - 150,000</td>
<td>Good</td>
</tr>
<tr>
<td>150,000 - 250,000</td>
<td>Very Good</td>
</tr>
<tr>
<td>250,000 - 500,000</td>
<td>Excellent</td>
</tr>
<tr>
<td>&gt; 500,000</td>
<td>Outstanding</td>
</tr>
</tbody>
</table>

EPA Tracked Sites
- Abandoned Mine Land
- Brownfield
- RCRA
- Federal Superfund
- Non-Federal Superfund
- Landfill

Screening Criteria
- Cumulative crop residues of 330,000 metric tons/year or greater within 50 miles (includes residues from: crops; forests; primary and secondary mills; and urban wood waste)
- Property size of 50 acres or more
- Distance to graded roads of 3 miles or less
- Distance to rail lines of 8 miles or less
Biofuels and agricultural landscapes in California and the United States: What do soils and climate have to do with it?

Steve Kaffka
Air Resources Board
Sustainability Work Group
September 15, 2010
<table>
<thead>
<tr>
<th>Category</th>
<th># cited</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nutrients in rivers</td>
<td>4</td>
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<tr>
<td>Greenhouse gases</td>
<td>7</td>
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<tr>
<td>Soil quality</td>
<td>8</td>
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<tr>
<td>Water quality</td>
<td>4</td>
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<tr>
<td>Crop genetic diversity</td>
<td>7</td>
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<tr>
<td>Ecosystem diversity</td>
<td>7</td>
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<tr>
<td>Biodiversity</td>
<td>2</td>
</tr>
<tr>
<td>Nutrient use</td>
<td>6</td>
</tr>
</tbody>
</table>

Survey of 16 different sustainability standards. Source: Field to Market: Keystone Alliance
CARB/Soil Quality

What influences farming systems?

1. climate and soils
2. economic incentives
3. regulations

Could biofuel feedstocks be produced in California? Yes, but the optimal crops or crop residues will vary with location.
Soils vary significantly across the California landscape.
The soils of California’s valleys were formed via erosion of parent materials eroded from the bordering hills and mountains and deposited over geologic time.
Soil age:

oldest                100K               30-80K             10K                            youngest

Hardpans, thick clay layers, (vernal pools)

Soils with structured horizons
A: Bt: C

Silts, loams low OM, crusting

High clay content, drainage limitations, salinity, alkalinity

Oak-savanna/rangelands
rangeland/pasture, some perennials

Soil use

perennials, annuals
mostly annuals
There are a number of distinctive farming regions in California. In the northeast (the upper Klamath Basin and areas around the Pitt and Fall Rivers), small grains, potatoes, wild rice and forages are the primary crops.
Tule Lake and farming regions in the Tulelake Irrigation District
Soils in the TID and elsewhere in the UKB are unusual mixtures of volcanic minerals, diatomite and organic matter. These were formed under shallow lakes, are fertile and have excellent drainage properties.
Some of the highest yields of spring wheat in the world are produced in the TID. Potatoes are the most important crop.
Coastal regions of California produce highly valuable horticultural crops year-round.
Grape prices and total production continue to rise in California. Since 2000, an average of 175 new wineries have opened each year. Above, V. Sattui Winery in the Napa Valley was established in 1885.
Coastal Valleys produce cool season vegetables, strawberries and citrus in the south. Soils are generally well-drained, allowing harvest year round.
the coastal mountain valleys and hills, dry-farmed wheat and alfalfa is still produced, complementing cattle ranching.
Dry-farmed safflower
Cattle graze crop residues, and annual grasses on the hillsides.
The most important agricultural region is the Central Valley
California’s Sacramento Valley
Approximately 500,000 acres of rice are grown in the Sacramento Valley annually on fine-textured soils that once supported either ephemeral or perennial marshlands.
The Delta is a unique region in California with high organic matter soils. Wheat and corn are the most common crops, but others increasingly are grown.
The San Joaquin Valley has had the largest economic value of any farming region in California, and is one of the most productive farming regions in the world. Soils vary significantly in quality.
Western San Joaquin Valley under full irrigation
Over 600,000 ac of almonds are produced in the SJV and SV. Drip irrigation has allowed an expansion in area.
Wine and table grapes and raisins are produced in the SJV, primarily in the eastern side of the valley where soils are sandy.
The western San Joaquin Valley generally has finer textured soils than the eastern side of the valley and areas with elevated levels of salinity and trace elements derived from marine shale parent material in the coastal mountains.
Cantua Creek in the WSJV

CV-WRCB

4.19.2006
Center pivot irrigation Five Points

Processing tomatoes

Field corners can be used for other crops
Safflower harvest in the Tulare Lake Bed near Corcoran. These soils are poorly drained and somewhat saline.
Saline-sodic soil near Stratford

Shallow, saline water table
Drainage water reuse project at Westlake Farms near Stratford

Cattle grazing Bermuda grass at Westlake Farms soil salinity research site, irrigated using diverse water sources, including saline drainage water and municipal waste water.
The San Joaquin Valley is home to more than 1,000,000 dairy cows, primarily in Tulare, Kern and Merced Counties.
The Imperial Valley has mostly fine-textured soils derived from erosion of the Grand Canyon. Winter vegetables and fruits, alfalfa and other forages, and other arable crops like durum wheat and sugar beets are produced.
All American Canal transports water from the Colorado River to the Imperial Irrigation District
Sugarbeets in Imperial Valley
Most irrigation in the IV is surface irrigation. Runoff from farms is the water source for the Salton Sea.
Desert Sky Farms, Imperial Valley, sugarbeet harvest
High yields of both sugarbeets and sugarcane are possible in the Imperial Valley.
LTRAS Project / Winters, California
Fig. 1. Maize yields, 1994-2004, LTRAS
Total C input over 10 years of cropping

Kong et al. 2004
Vegetation patterns and farming systems across the United States are a function of precipitation and soils.
USDA’s classification of agricultural regions
CORN NET EXPORTS (+) AND NET IMPORTS (-), 09-10

<table>
<thead>
<tr>
<th>Period</th>
<th>Rail &amp; Truck</th>
<th>Lakes</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>WestCN</td>
<td>EastCN</td>
<td>AllCN</td>
</tr>
</tbody>
</table>
| 07-08  | 87      | 30     | 6     | 80
| 08-09  | 37      | 31     | 3     | 123
| 09-10  | 59      | 35     | 4     | 71
| Change | 22      | 5      | 1     | -52

Includes other West Coast Exports (including via container)

Courtesy of PRX, Inc.
Iowa, native grasses

No-till or reduced-till corn production in Iowa

Iowa, native grasses
Kansas, wheat and native grass pasture
How does soil quality affect farming? Can it be maintained or improved while farming commercially? How will biofuel crops affect soil quality? What should sustainability standards say, if anything, about soil quality?