Solar Tractors for Agriculture

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U.S. Per Person Barrels of Oil Equivalent Used (yearly)

- Food: 10
- Cars: 9
- Houses: 7

0 Oil Equivalents/Person
Total Energy Consumed in US Farms in 2002
Total = 1.7 Quadrillion BTUs
(1.8 Exajoules)

- Fertilizers: 28%
- Diesel: 27%
- Electricity: 21%
- Gasoline: 9%
- Pesticides: 6%
- LP Gas: 5%
- Natural Gas: 4%
Oil and food commodity prices, in lock step
Fossil Fuel Inputs for Global Ag Biz

10 units of fossil energy for = 1 unit of food energy

- 28% for the manufacture of fertilizer
- 20% for the operation of field machinery
- 10% for farm and wholesale transportation
- 11% for irrigation
- 9% processing
- 10% retail distribution
- 8% miscellaneous

100%
Fossil Fuel Inputs for Global Organic

8 units of fossil energy for 1 unit of food energy

- 24% for the operation of field machinery
- 12% for farm and wholesale transportation
- 11% for irrigation
- 9% processing
- 12% retail distribution
- 12% miscellaneous

80% of Global Ag Biz
Fossil Inputs for Regional Organic

6 units of fossil energy for = 1 unit of food energy

• 24% for the operation of field machinery
• 8% for farm and wholesale transportation
• 11% for irrigation
• 8% processing
• 5% retail distribution
• 4% miscellaneous

60% of Global Ag Biz
Fossil Inputs for Local Organic

5 units of fossil energy for = 1 unit of food energy

- 24% for the operation of field machinery
- 5% for farm and wholesale transportation
- 8% for irrigation
- 6% processing
- 5% retail distribution
- 3% miscellaneous

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50% of Global Ag Biz
Fossil Inputs for Local Permaculture

3 units of fossil energy for = 1 unit of food energy

- 5% for the operation of field machinery
- 5% for farm and wholesale transportation
- 6% for irrigation
- 6% processing
- 5% retail distribution
- 3% miscellaneous

30% of Global Ag Biz
Fossil Inputs for Labor Intensive

2 units of fossil energy for = 1 unit of food energy

- 3% for the operation of field machinery
- 5% for farm and wholesale transportation
- 3% for irrigation
- 2% processing
- 5% retail distribution
- 2% miscellaneous

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20% of Global Ag Biz
Solar/Electric Small Farm

.01 units of fossil energy for = 1 unit of food energy

- 0% for the operation of field machinery
- 0% for farm and wholesale transportation
- 0% for irrigation
- 0% processing
- 0% retail distribution
- 1% miscellaneous

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1% of Global Ag Biz
Solar Charged Electric Tractors

Tractors require weight for traction

Batteries provide useful weight for traction
E- Porsche and E-Tractor ‘93

E-tractors Built in Ft. Bragg shop ‘94

Built for Ford-New Holland ‘95

Onboard inverter for mobile AC power
Scratch built with wheel motors and adjustable seat 1996
Allis Chalmers “G” Electric Conversion
Food beyond Oil with Solar Charged Electric Tractors
Exchangeable Battery Packs for Extended Range

Exchangeable pack mounted in the front to balance rear implement

Exchangeable pack mounted in the back to balance front loader
Drive Train Efficiency

Loss
- Combustion: 20%
- Mechanical: 5%
- Drive Train: 62%
- Idling: 95%

Gain
- Work: 10%
- Regen: 10%

ICE & Transmission
- 62%

Electric Wheel Motor
- 20%

Heckeroth, 5-20-07
Land Area and Water Needed to Fuel Farm Traction without Oil

40 Acre Horse Farm
* New Mexico Horse Council

20-80 Acres Pasture for 2 Horses
1-5 Acres Winter Feed
Over 300,000 gallons

40 Acre Bio-Fuel Farm
* Missouri Ag extension

10 Acres Soy Beans for 600 gal
30,000 gallons

40 Acre Solar/Electric Farm
0.005 Acres of Barn Roof
No Water
SolTrac with Solar Charging Tractor Shed in the Background
Barn Roof Power Plants

My Homestead ‘93

The Mother Earth News 2006
## Comparing Fossil Fuel with Solar Charging

<table>
<thead>
<tr>
<th>Vehicle Type &amp; Fuel Source</th>
<th>Combustion</th>
<th>Electric tractor &amp; 1.5 kW PV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid fuel used</td>
<td>7,500 gals</td>
<td>ZERO</td>
</tr>
<tr>
<td>300 hrs/yr for 25 yrs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Energy used 25 yrs</td>
<td>250 MWh</td>
<td>60 MWh</td>
</tr>
<tr>
<td>Fuel cost/hr</td>
<td>$10.00</td>
<td>$0.80</td>
</tr>
<tr>
<td>Fuel cost/yr</td>
<td>$3,000</td>
<td>$240</td>
</tr>
<tr>
<td>Fuel cost over 25 yrs</td>
<td><strong>$75,000</strong></td>
<td><strong>$6,000</strong> *</td>
</tr>
<tr>
<td>$10.00/gal, $4/watt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO₂ / 25 years</td>
<td>100 tons</td>
<td>trace</td>
</tr>
</tbody>
</table>

**Assumptions average next 25 yrs:** 1 gal/hr, $10.00/gal, 30kWh/gal, 28#s CO₂/gal, *Current installed cost and performance for 1.5 kW PV w/ 25 year warrantee*

Heckeroth, 10-28-10
10 million Small Farm Tractors in the US
600 hours/year for 25 years

**Oil-combustion**
At $75,000/tractor X 10 M tractors
= $3,250 billion total
No New Jobs
Money Leaves the US Economy
+ 1 billion tons of CO₂

**Solar- electric**
At $6,000/tractor X 10 M-1.5kW PV
= $60 billion total
Millions of New Jobs
Money stays in the US Economy
NO CO₂

Assumptions average next 25yrs : 1 gal/hr, $10.00/gal, 30kWh/gal, 28#s CO2/gal,
*Current installed cost and performance for 1.5 kW PV w/ 25 year warrantee

Heckeroth, 10-28-10
Solar Energy Can Fuel Agriculture

35 Billion Terawatt hours (TWh) of Solar Energy Struck the Earth Over the Last 100 years

0.0005 Billion TWh of Oil has been burned Over the Last 100 years

6 hours of sunshine is equal to all the oil burned over the last 100 years

(the sun will keep on burning for 5.5 billion years)

The real shortages we have are Innovation and common sense

(the oil will be gone in the next 30 years)

Heckeroth, 3-28-08
Combustion Economy

- Combustion depletes stored energy resources, reduces the quality of essential resources and will cause conflict and economic collapse.

Agrarian Economy

- Reliance on fossil energy has allowed population growth that can not be sustained by manual labor or beasts of burden.

Solar/Electric Economy

- Moving toward reliance on clean energy from the sun will stabilize the quality of essential resources and allow positive evolution.

Heckeroth, 6-8-04
30 years of oil left

5,500,000,000 years of sunshine left

Choose Wisely