Solar Tractors for Agriculture

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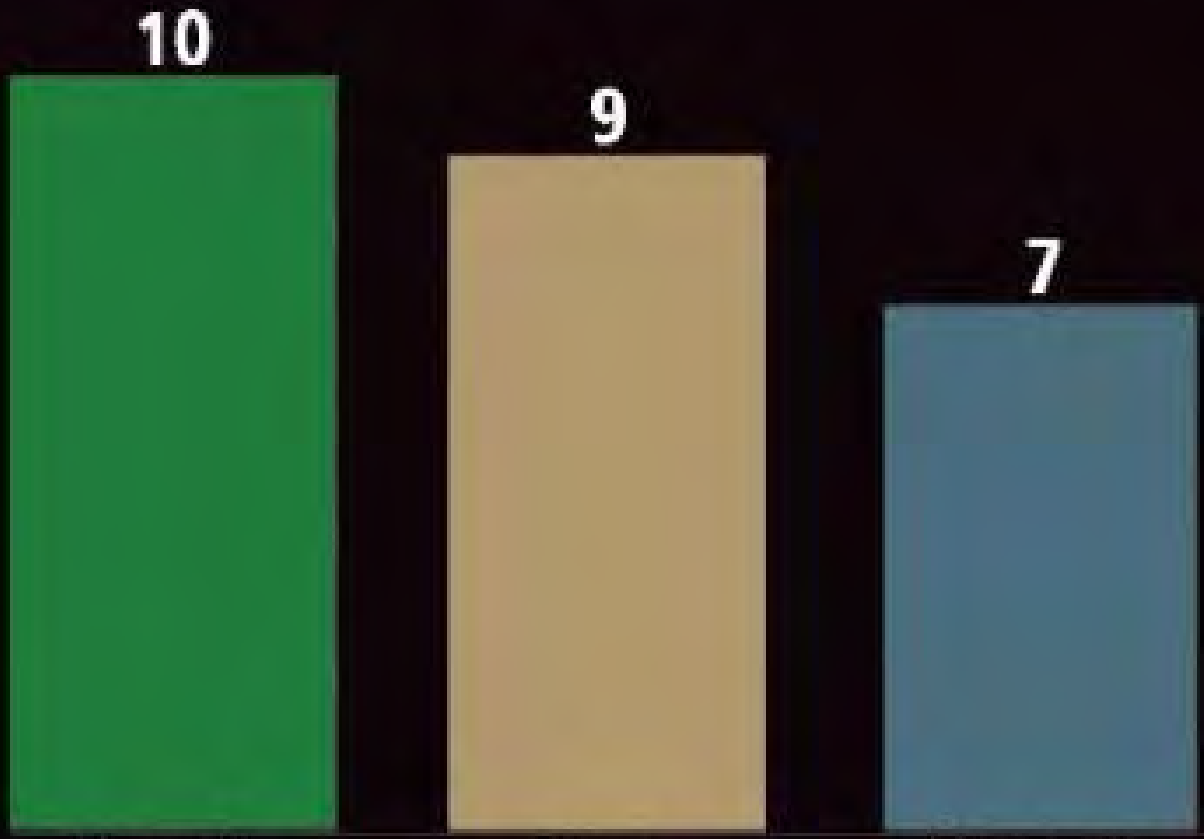
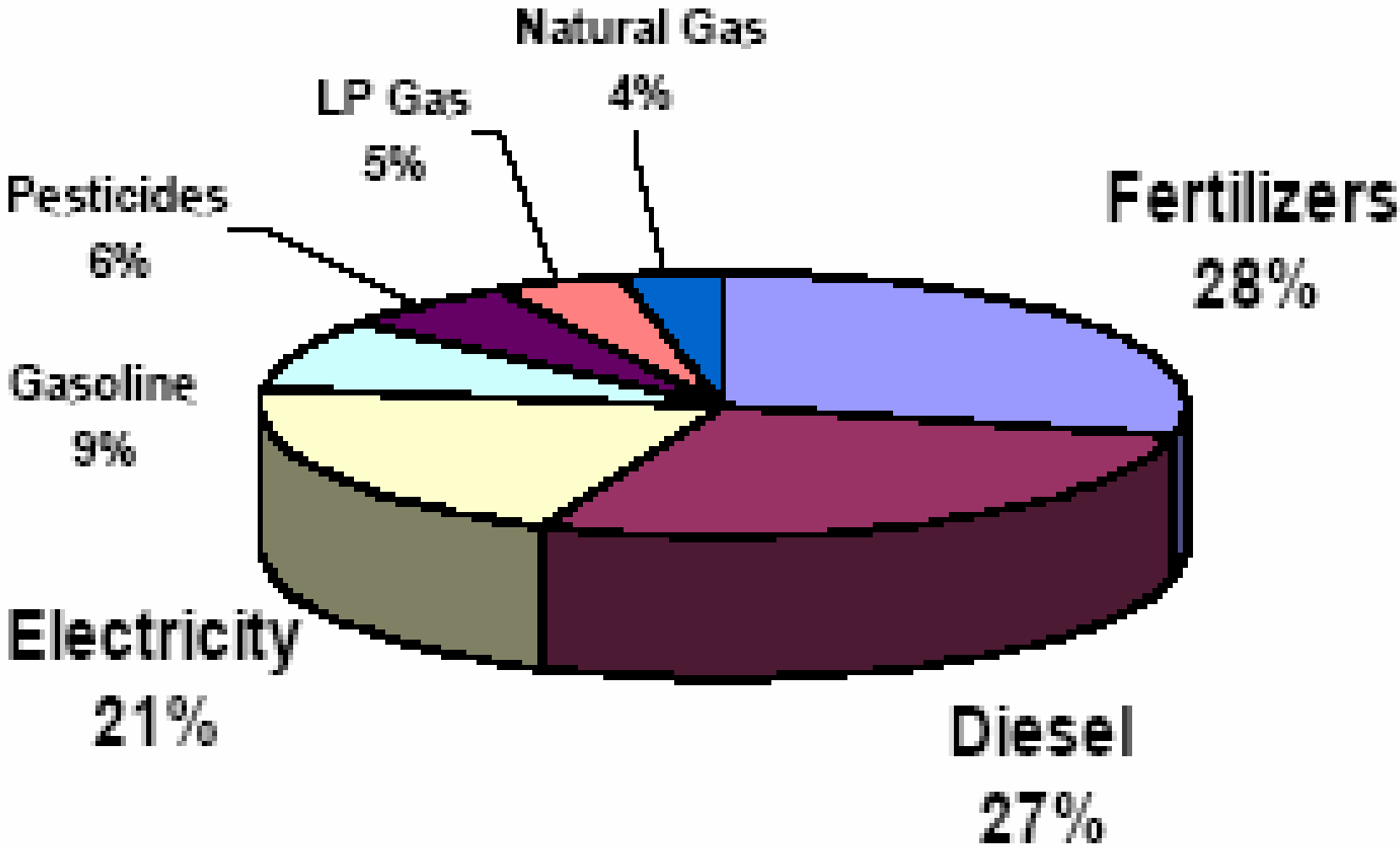
U.S. Per Person Barrels of Oil Equivalent Used (yearly)

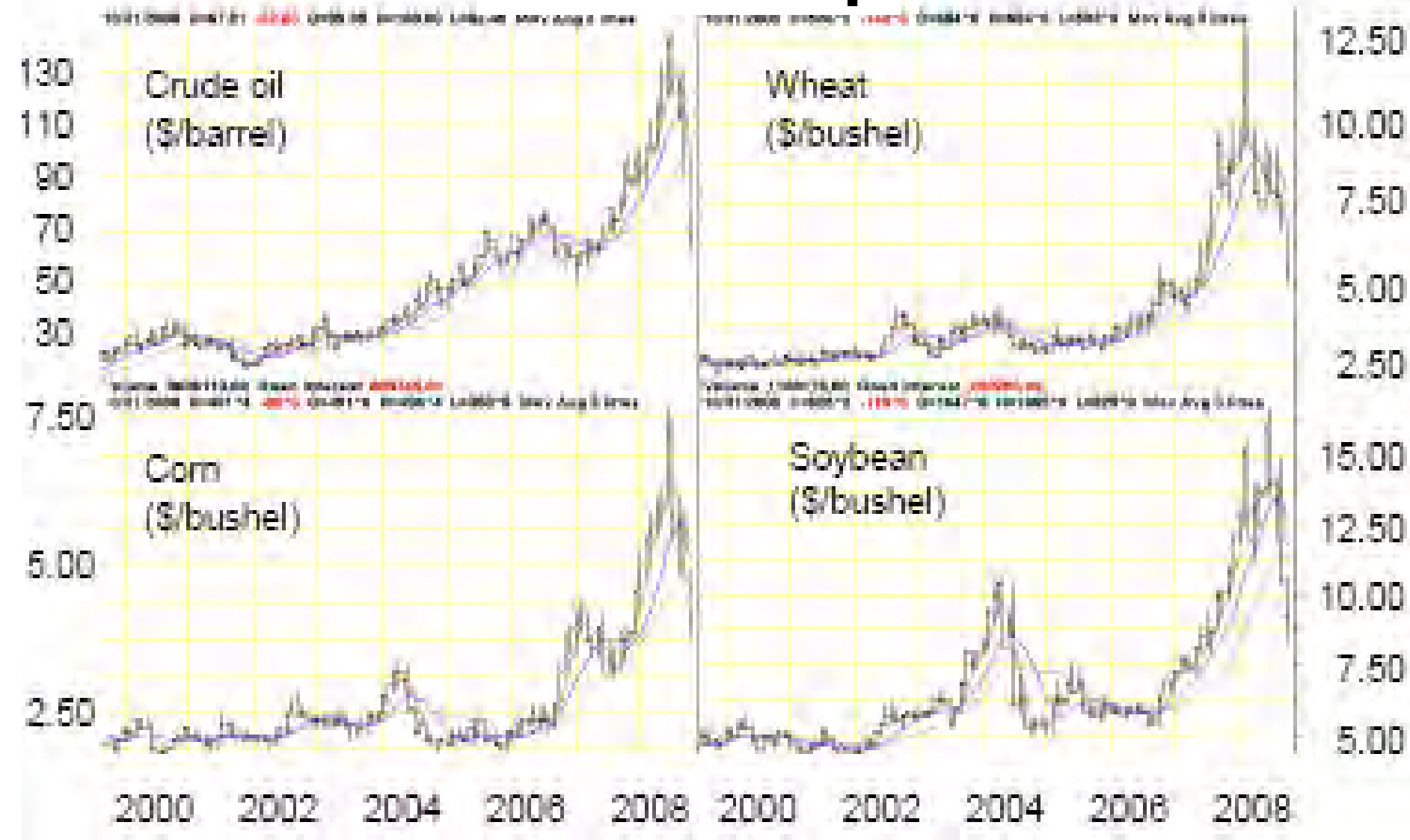


0 Oil Equivalents/Person

Total Energy Consumed in US Farms in 2002
Total = 1.7 Quadrillion BTUs
(1.8 Exajoules)



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**

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**

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**

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

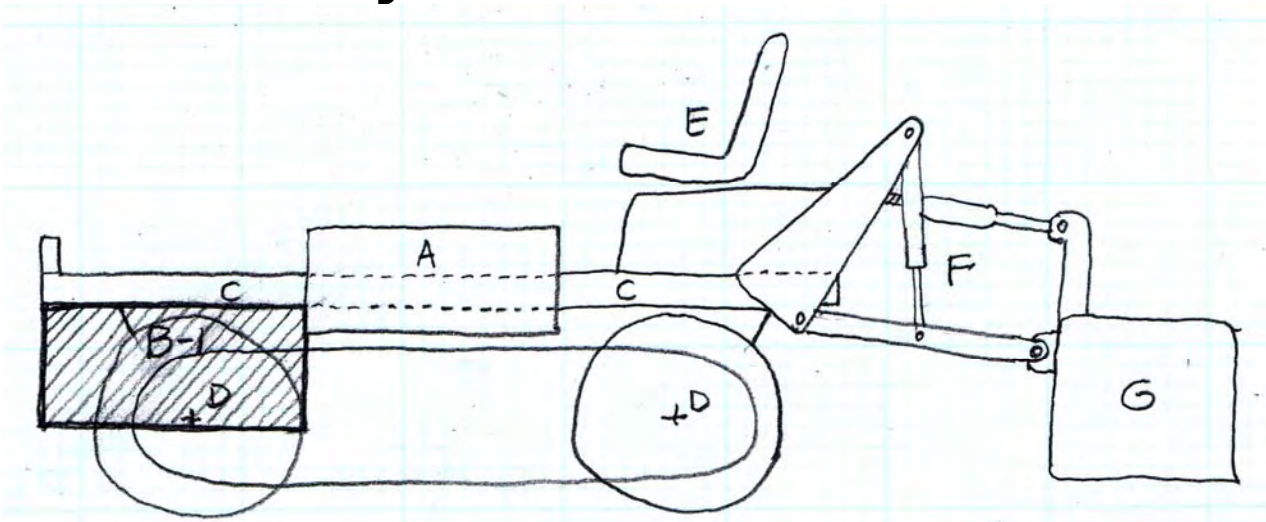
Onboard inverter for mobile AC power

Scratch built with wheel motors and adjustable seat 1996

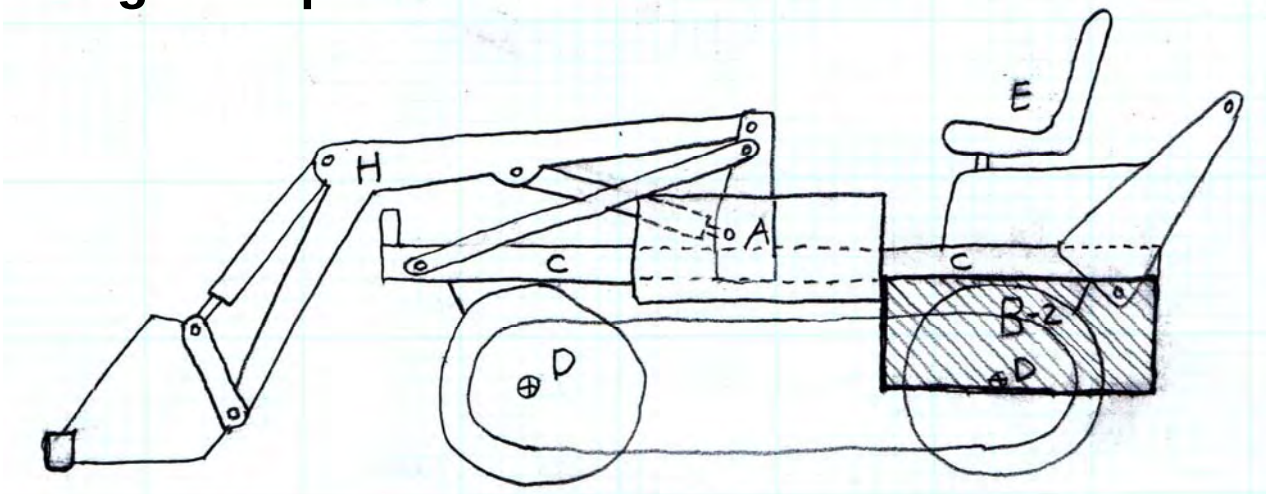
Scratch Built Crawlers 2008

Allis Chalmers “G” Electric Conversion
Food beyond Oil with Solar Charged Electric Tractors

Exchangeable Battery Packs for Extended Range

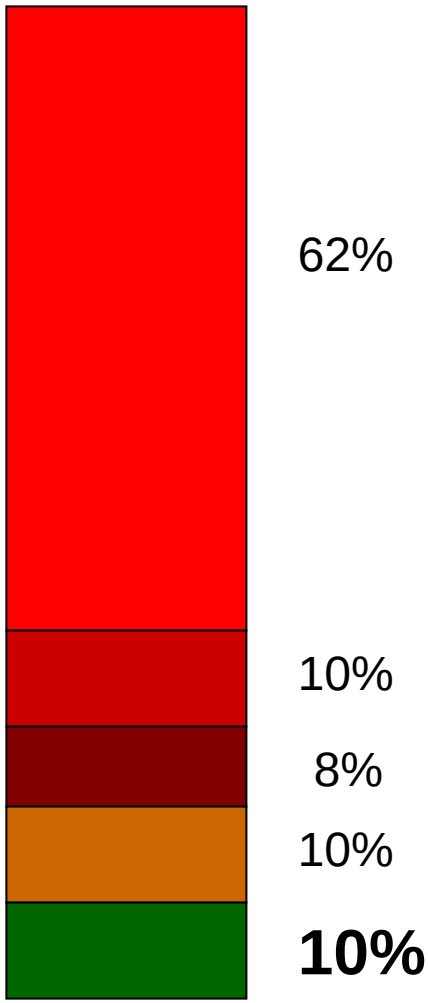


Exchangeable pack mounted in the front to balance rear implement



Exchangeable pack mounted in the back to balance front loader

Drive Train Efficiency



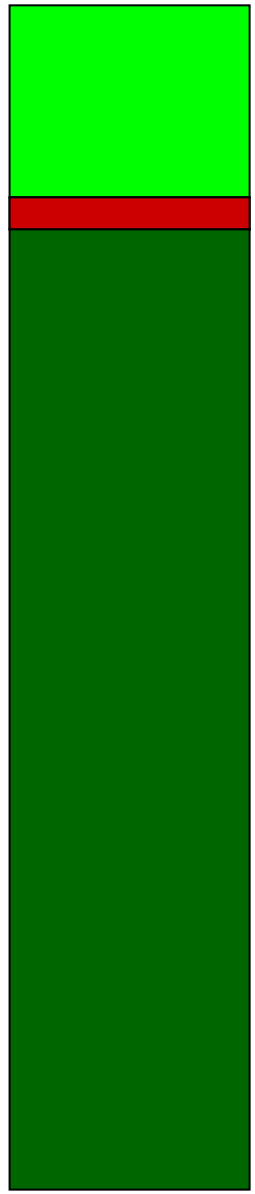
ICE & Transmission

Loss

- **Combustion**
- **Mechanical**
- **Drive Train**
- **Idling**

Gain

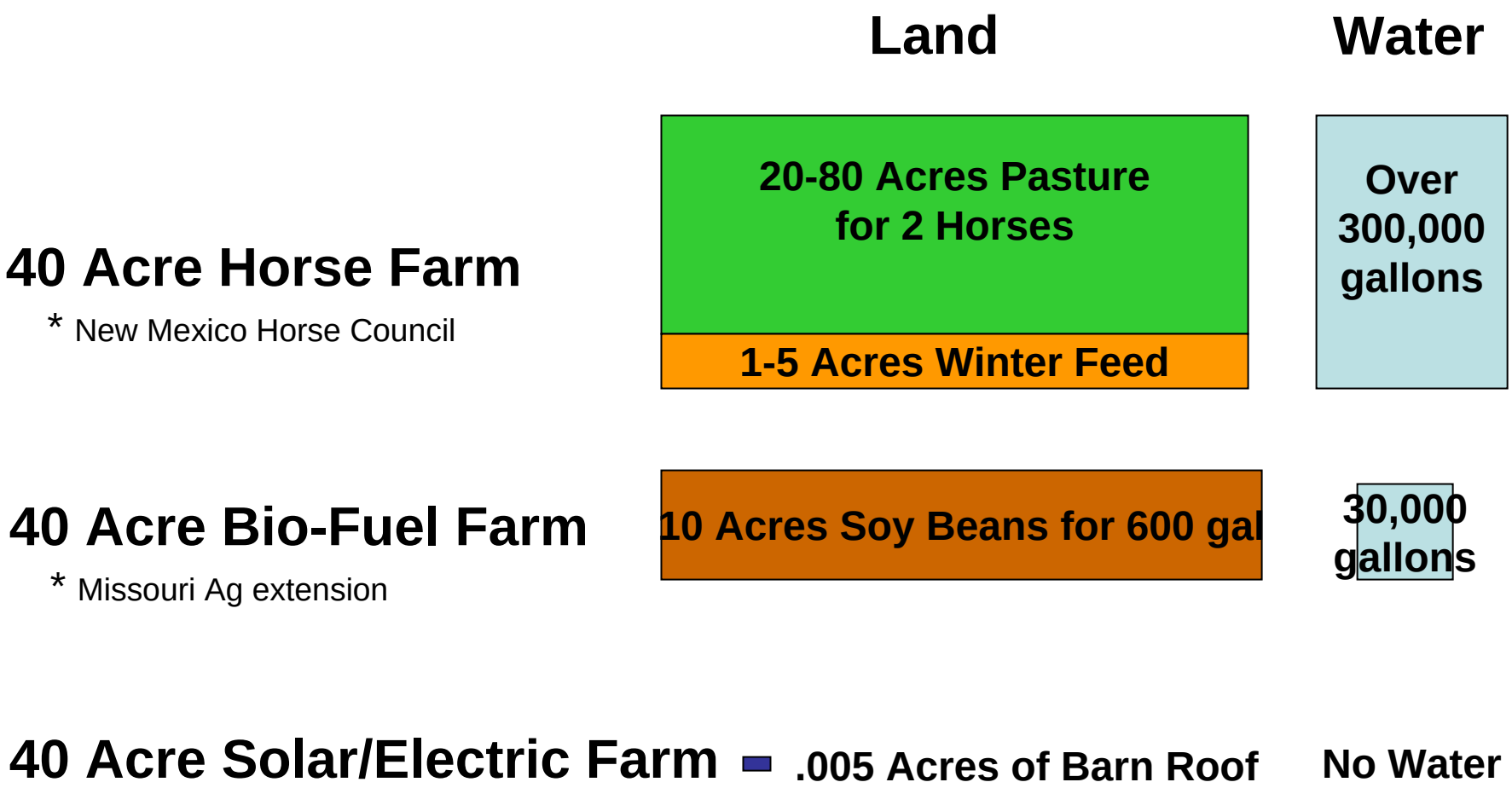
- **Work**
- **Regen**



Electric Wheel Motor

Heckeroth, 5-20-07

Land Area and Water Needed to Fuel Farm Traction without Oil



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

Vehicle Type & Fuel Source	 **Combustion**	 **Electric tractor & 1.5 kW PV**
Liquid fuel used 300 hrs/yr for 25 yrs	**7,500 gals**	**ZERO**
Energy used 25 yrs	**250 MWh**	**60 MWh**
Fuel cost/hr	**$10.00**	**$0.80**
Fuel cost/yr	**$3,000**	**$240**
Fuel cost over 25 yrs $10.00/gal, $4/watt	**$75,000**	**$6,000 ***
CO_2 / 25 years	**100 tons**	**trace**

Assumptions average next 25yrs : 1 gal/hr, $10.00/gal, 30kWh/gal, 28#s CO_2/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 CO_2

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 CO_2

Assumptions average next 25yrs : 1 gal/hr, $10.00/gal, 30kWh/gal, 28#s CO2/gal,

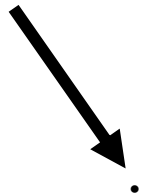
***Current installed cost and performance for 1.5 kW PV w/ 25 year warrantee**

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

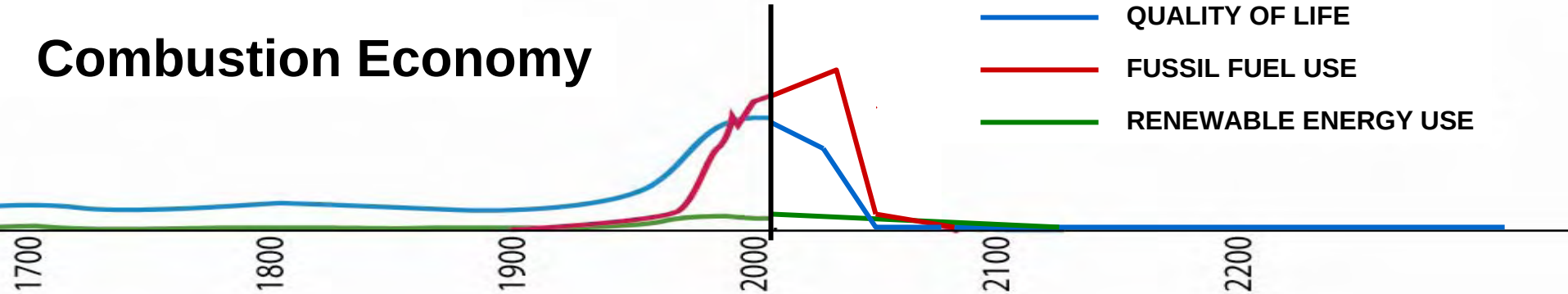
(the sun will keep on burning for 5.5 billion years)

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

The real shortages we have are Innovation and common sense

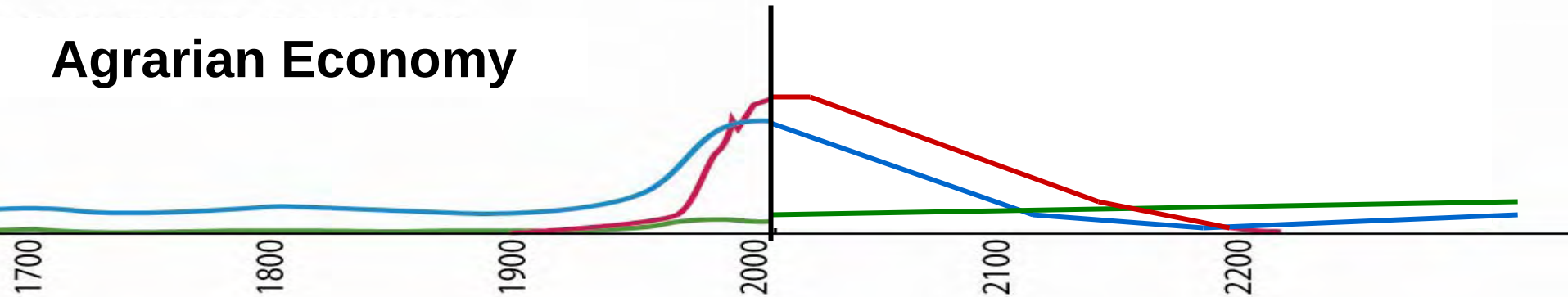
Heckeroth, 3-28-08

Combustion Economy



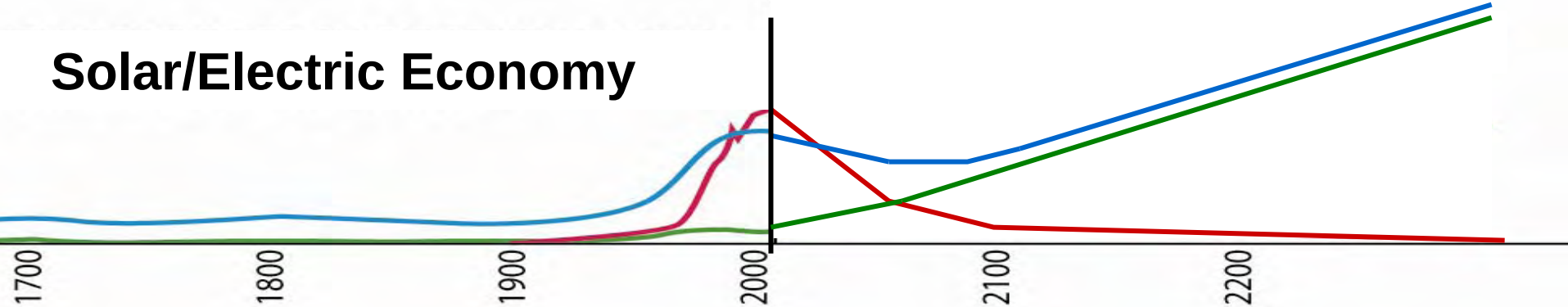
combustion depletes stored energy resources, reduces the quality of essential resources and will cause conflict and economic collapse

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