Life after Cheap Carbon: The Transition to a Resilient, Renewable Energy Economy

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Bad News

We depend on petroleum and other fossil fuels.

They are running out.
Good News

There is more than enough renewable energy to replace them.
Bad News

We cannot access those renewables soon enough to avoid a contraction in energy supply.

The years of increasing energy consumption are over for the USA.
Good News

There are plenty of opportunities to reduce energy demand without compromising human wellbeing.
Photosynthesis: *Forests from thin air*
GLOBAL DISTRIBUTION OF ATMOSPHERIC CARBON DIOXIDE

CO₂ (ppm)

Latitude

Longitude

YEAR

SOUTH POLE

CO₂ (ppm)

YEAR
US Energy Consumption, 1950-2025
US Energy Consumption, 1950-2025
US Energy Supply & Demand, 2009
(Total: 94.6 Quadrillion BTU)
Energy as % of US consumer spending

I believe the Great Creator has put ores and oil on this earth to give us a breathing spell ... As we exhaust them, we must be prepared to fall back on our farms, which are God's true storehouse and can never be exhausted. For we can learn to synthesize materials for every human need from the things that grow.

-George Washington Carver
We waste what is cheap.
US 48 states oil production has been declining since 1970

Data from DOE-EIA, 2009
World Oil Production, 1960-2009

Million Barrels per Day

The USA uses a lot of energy and emits a lot of greenhouse gas.
Per capita greenouse gas emissions (t CO₂ equiv.)

Per capita energy use (GJ/yr)
KY Plans to Increase Fossil Fuel Use

Figure 10: Kentucky Total Energy Consumption and Savings Potential (2025 Goal)

* Historical renewable energy was derived from hydroelectric (52-75%) and biomass (24-45%); remainder was unspecified "other."
(Source: EIA, http://www.eia.gov/ems/state/akp_energy_use/tot_ele_elec_1044.html)
KY Energy Use, 1995-2007

-18% to +15%
Energy Efficiency will offset at least 18% of Kentucky’s projected 2025 energy demand.

-- Intelligent Energy Choices for Kentucky’s Future, GOV. Steven L. Beshear, 2008
Renewable Energy Availability Exceeds Current Consumption

- Solar: 86,000 TW
- Wind: 870 TW
- Hydro: 7.2 TW
- Geothermal: 32 TW
- Global Consumption: 15 TW
Solar

• Plenty of sunlight
  – 0.025% would satisfy world electricity demand

• Photovoltaic
• Solar Thermal
• Passive Solar

Data from DOE-EIA, 2010
Geothermal

- Heat within earth
- Huge potential, poorly developed
- Direct heat, electricity generation
  - Ground source heat pumps
  - Steam turbines
  - Enhanced Geothermal Systems
- Works best in areas with volcanoes, seismic activity
- Constant supply
- Heat can be depleted locally
Wind

- Plenty of wind
  - Possible to meet current electricity demand many times over
- US produces more wind energy than any other country
- Intermittent
- Often remote
- Requires major grid upgrade
Hydro

• 15% of electricity globally
• 6.5% of electricity in the USA
• 1/3 of hydro power potential developed

Data from DOE-EIA, 2010
Biomass

- Wood, plant material, manure
- Once sole source of energy, now 13% of total energy consumed globally
  - Excluding fossil fuels, which are ‘aged’ biomass
- Filtered through photosynthesis
  - Inefficient: 92 - 99.9% lost
- Production limited by land, temperature, water, nutrient availability, farm energy demands, farm labor, farmer skill…
Perennial grass crops

Hay

\[ y = -0.0005x^2 + 1.9008x - 1897.7 \]

\[ R^2 = 0.9327 \]

Sugarcane

\[ y = -0.0019x^2 + 7.554x - 7307.6 \]

\[ R^2 = 0.475 \]

USDA-NASS. 2009. Crop Production Historical Track Records

Data from DOE-EIA, 2010

Data from DOE-EIA, 2010

Quadrillion BTU

- Renewable production
- Non-renewable production
- Total production
- Total consumption

Data from DOE-EIA, 2010

Renewable production
Non-renewable production
Total production
Total consumption

1979-83
Consumption falls by 7.9 quads.
Fall 11 years in 4.
Renewable production is 6.6 quads.

2007-09
Consumption falls by 6.9 quads.
Fall 13 years in 2.
Renewable production is 7.8 quads.

Data from DOE-EIA, 2010
Renewable energy sources will not meet our current energy demand in the near term
Renewable energy sources with best long-term potential (solar, wind, geothermal) are least developed
Conservation is imperative
We have become ninety-nine percent money mad. The method of living at home modestly and within our income, laying a little by systematically for the proverbial rainy day which is due to come, can almost be listed among the lost arts.

"-George Washington Carver
We are not good at predicting what will make us happy

**What does**
- Time with friends, family
- Meaningful work
- Success / Recognition
- Autonomy
- Absorbing activity
- Doing things well
- Contributing to society
- Gratitude
- Forgiving easily

**What doesn’t**
- Bigger houses
- Bigger cars
- More driving
- More stuff
- Less time
“The best Southern small city for families? Tiny Frankfort, Ky., with a population of only 69,659. It ranks No. 20 on our nationwide list...”
The best Southern small city for families? Tiny Frankfort, Ky., with a population of only 69,659. It ranks No. 20 on our nationwide list...”
US Food System
Energy Use, 2002

Non-food 85%
Food 15%

Agriculture 2%
Processing 3%
Packaging 1%
Food service 2%
Wholesale & retail 2%
Transportation 1%

The U.S. food system used 2.56 qBtu more energy in 2002 than in 1997.

1997 energy use, 11.54

Growth in energy use, 1997 to 2002, 2.56

Population growth, 0.64
Greater per capita food expenditures, 0.65
Higher energy-using technologies, 1.27
Why Is Our Food System Using More Energy?

- More fridges, bigger fridges
- More appliances
- More packaging
- More processed foods
- More convenience foods
- More eating out

- “No time for food”
The Post Carbon Age

• Time for community, household, family, food…

• Increasing quality of life instead of increasing income, consumption…

• “Smart growth” displaced by “intelligent decline”…

• Cutting back on energy use while ramping up renewable energy production…
Want more?

Blogs:
- Energy Farms
  - Energyfarms.net
- Organic Kentucky
  - oak-ky.org/blog

Released in October...
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Published in 2009
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