

Driving Away From the Oil Economy

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**Green Vehicles Workshop
Milwaukee Area Technical College**

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About RENEW Wisconsin



Advocates for state-level sustainable energy policies since 1991

One of the architects of the state's Renewable Energy Standard and ratepayer-funded public benefits program

A Focus on Energy subcontractor promoting commercial solar thermal systems and reducing barriers to customer-sited renewable energy

An organized voice for renewable energy producers and purchasers!

Key Terms and Concepts

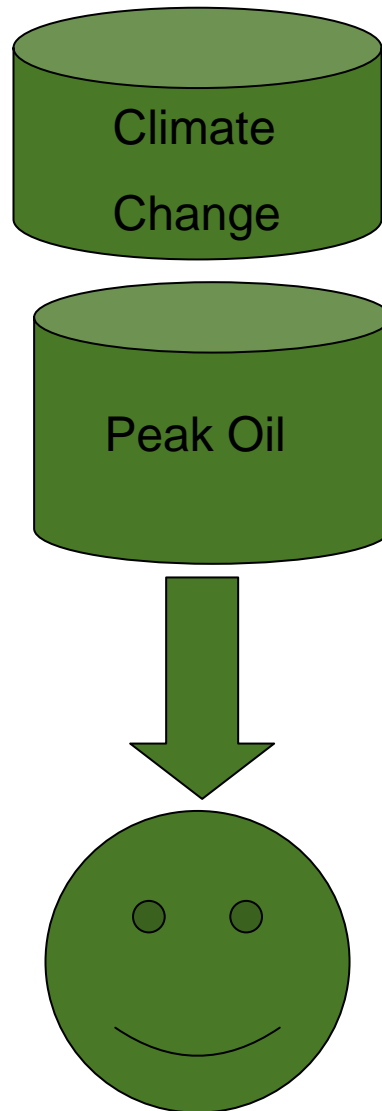
- Stores (fossil energy) vs. flows (renewables)
- On-demand energy vs. as-available energy
- Energy sources vs. energy sinks
- The Solar Ration (using the interest, not the principal)
- ✓ Energy Return on Energy Invested (EROEI)
 - *Transition from highly energetic resources like petroleum to less energetic resources means less wealth available for other activities*
- ✓ Hubbert's Curve (Peak Oil/Peak Energy)
- ✓ Energy literacy vs. energy numeracy

Overcoming Economics 101

“Anyone who believes exponential growth can go on forever in a finite world is either a madman or an economist.” – *Kenneth Boulding*

- Q. How many economists does it take to screw in a light bulb?
- A. None. If it really needed changing, market forces would have caused it to happen.

How effective will magical thinking be in dealing with these world-transforming problems?



Our descent down the energy canyon has begun. Unlike the animated world inhabited by Wile E. Coyote, our reality won't let us pull out a sign that says "how about ending this cartoon before I hit?"

It took us 125 years to use
the first trillion barrels of oil.
We'll use the next trillion in 30.

So why should you care?

willyoujoinus.com

DAVID J. O'REILLY
CHAIRMAN & CEO
CHEVRON CORPORATION



Energy will be one of the defining issues of this century. One thing is clear:
the era of easy oil is over. What we all do next will determine how well we meet
the energy needs of the entire world in this century and beyond.

August, 2005: Chevron Full Page Magazine Adds

Lessons from Petroleum Geologists

- Discoveries precede extraction; a peak in discoveries precedes a peak in extraction volumes
- Global oil discoveries peaked in 1964
- The largest oil structures are discovered first
- Today's discoveries replace 1 barrel for every 3-4 consumed
 - **This conclusion is not disputed**
 - **Technology will not change this reality**

Signs of Magical Thinking

Responding to the coming energy squeeze with the following assumptions

- We don't need to change our driving habits
- We can find convenient substitutes for oil
- We don't have to worry about mobilizing the capital needed to invest in successor energy sources
- We can support complex societies with less energetic fuel sources
- We don't need to re-engineer the built environment

Compared w/ climate change, Peak Oil packs an economic hammer

- Climate change is an externalized phenomenon. The economic impacts from increased CO2 emissions have had no material effect so far on energy usage worldwide.
- Oil underpins the global economy and has fed its remarkable growth since 1945. The economic signals from increasingly scarce supplies of petroleum will be disruptive and transformational.
- Whereas ethical considerations drive CO2 reduction strategies, the stark economic realities occasioned by Peak Oil will trump both Business As Usual *and* enlightened environmental policies.

Energy Return on Energy Invested

Electricity

- Nuclear 6
- Coal 8
- Hydro 12
- Wind 17+
- PV 6

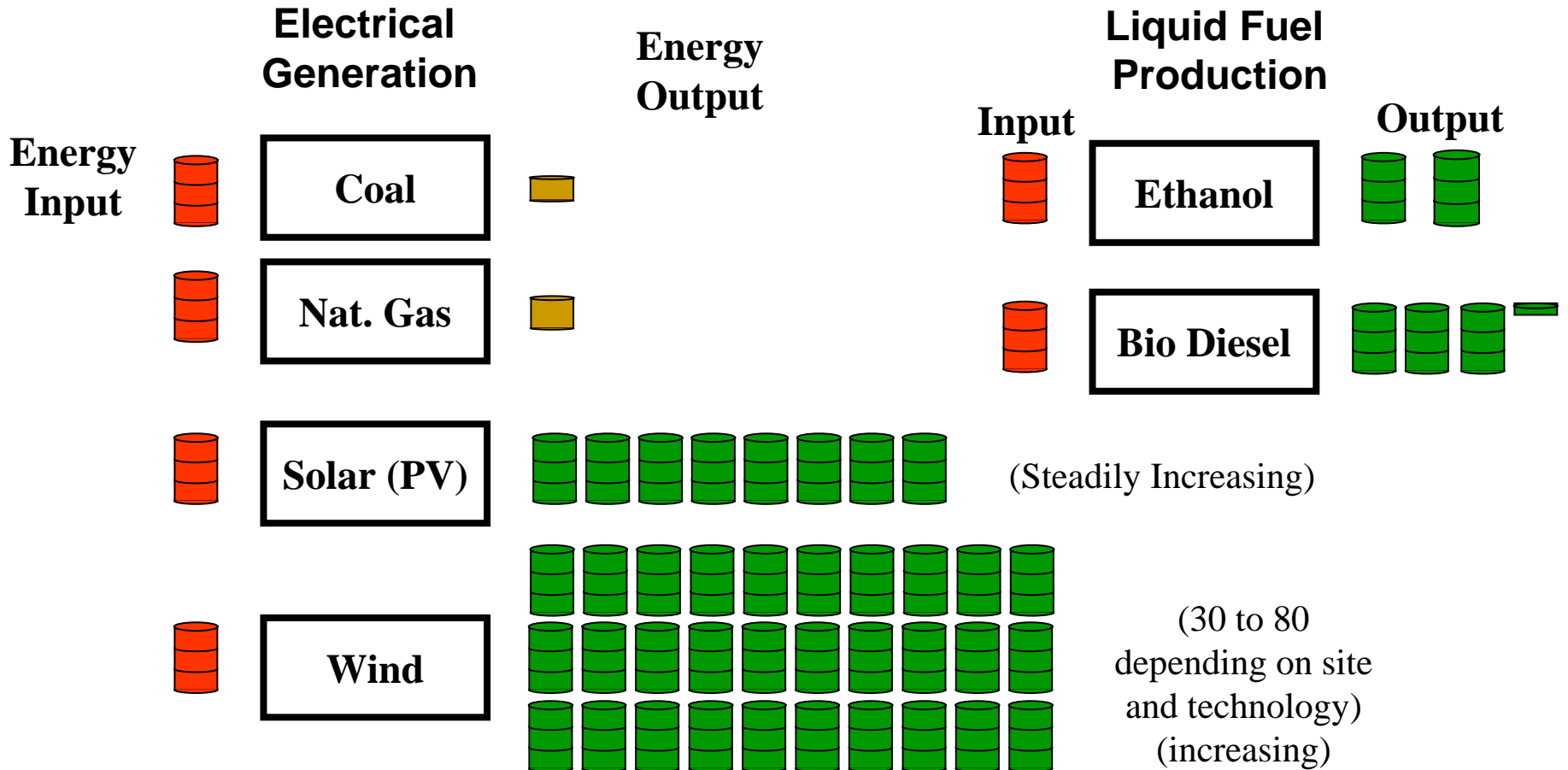
Liquid Fuels

- Crude Oil 20
- Gasoline 18
- Tar Sands 3-4
- Coal to Liquids 3
- Corn ethanol 2
- Biodiesel 3

THESE NUMBERS MATTER!!!

Source: Cutler Cleveland et al, Center for Energy + Environmental Studies, Boston Univ. (unpublished)

Where to invest the remaining fossil energy?



Note: Coal and Natural Gas energy output limited to combustion efficiency at a maximum. Fuel supply, plant construction and decommissioning, and O&M energy uses reduce output below combustion efficiency. Solar, wind and bio can have terrestrial energy output greater than one since they are accessing solar energy entering the terrestrial system from the sun. See: <http://www.awea.org/faq/bal.html>, <http://www.ecotopia.com/apollo2/knapp/PVEPBTPaper.pdf>

Implications for Transportation

- Renewable electricity is a superior alternative to biofuels for transporting people
 - Higher EROEI, creating more wealth
 - Cheaper – 50 miles/two gallons gasoline - \$6.60
50 miles/12 kWh windpower - \$1.60
 - Less price volatility – electricity is a regulated product – in contrast, diesel prices have increased 33% over the last 12 months - \$2.60 → \$3.90/gallon
 - Easy to access – plug in your vehicle
- Energy storage (battery lifespan and expense) remains an issue, limiting mobility and convenience

However ...

Most definitions of renewable fuels do not include electricity produced from solar, wind, hydro, and bioenergy. It is highly doubtful that renewable fuel standards above 10% can be achieved when renewable electricity sources are excluded from the mix.

Other Benefits of Electrified Transportation

- The grid offers multiple access points, including residences and workplaces
- A great use for nighttime wind energy
- Price of electricity not influenced by demand for food crops
- EV's last longer – require less maintenance
- Delivers far more CO2 reduction benefits than biofuels
- Takes demand pressure off nonrenewable liquid fuels
- Electrification makes higher-speed rail and transit systems a more cost-effective investment

What Are the Trade-Offs?

- Reduced mobility due to energy storage limitations, frequent recharges
- Smaller cars - less room for people and things
- Lower driving speeds – not suitable for highways
- Automobile manufacturers haven't figured out how to manufacture profits with EV's

Other Responses to Peak Oil

- Carpools, ride-sharing and jitney services
- Fewer, better-organized trips for running errands
- Reductions in discretionary travel
- Working at home more often
- Less aggressive driving behavior
- Exercise via self-propelled locomotion
- A more localized relationship with the world

So ... Can We Drive Away From the Oil Economy?

The answer to that question is “no.” But that question presupposes that limiting petroleum consumption is a choice, not an inevitability. Going forward, we will consume less liquid fuels than we do today. In fact, that is already happening.

A better question to ask is: can we change our current habits and attitudes to transition into a less mobile but more sustainable future relying on renewable energy flows and low-EROEI energy stores?

Questions?

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