



# Energy-Lifeblood of Modern Society

*What is the BIG Picture?*

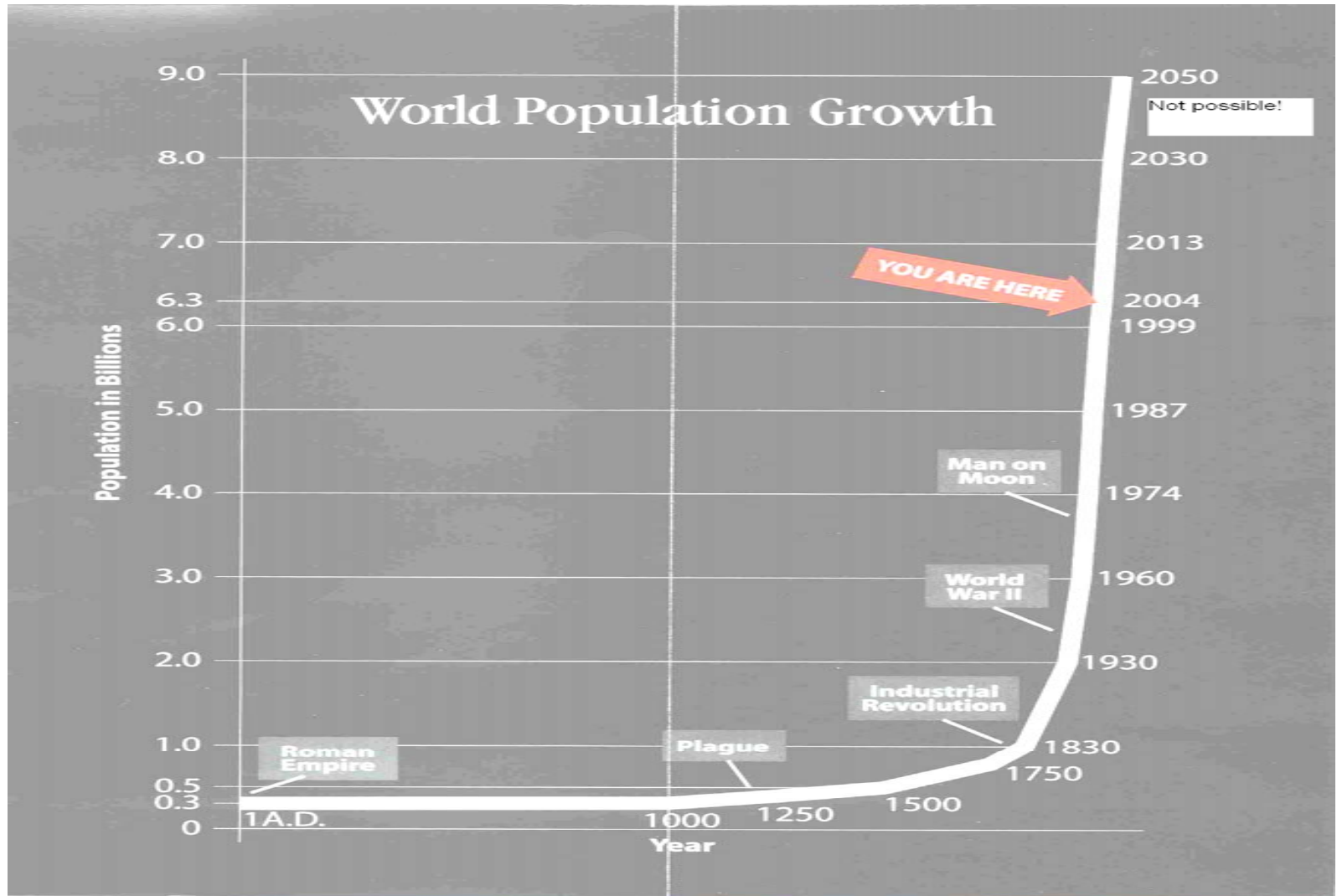
*David Blittersdorf – Founder/CTO*

*May 6, 2005*

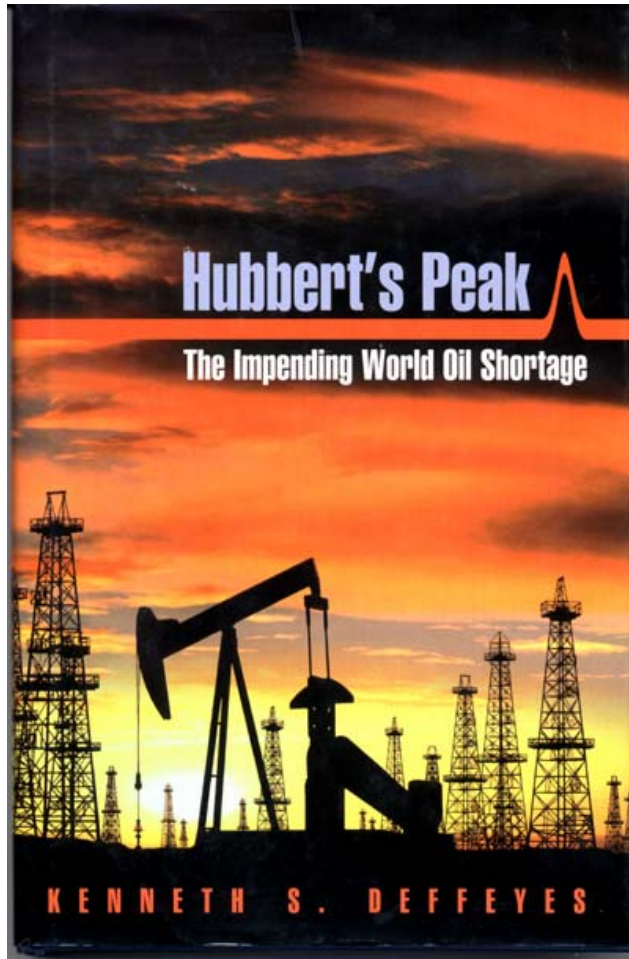
*SUNY-Canton, NY Sustainable Energy Fair*



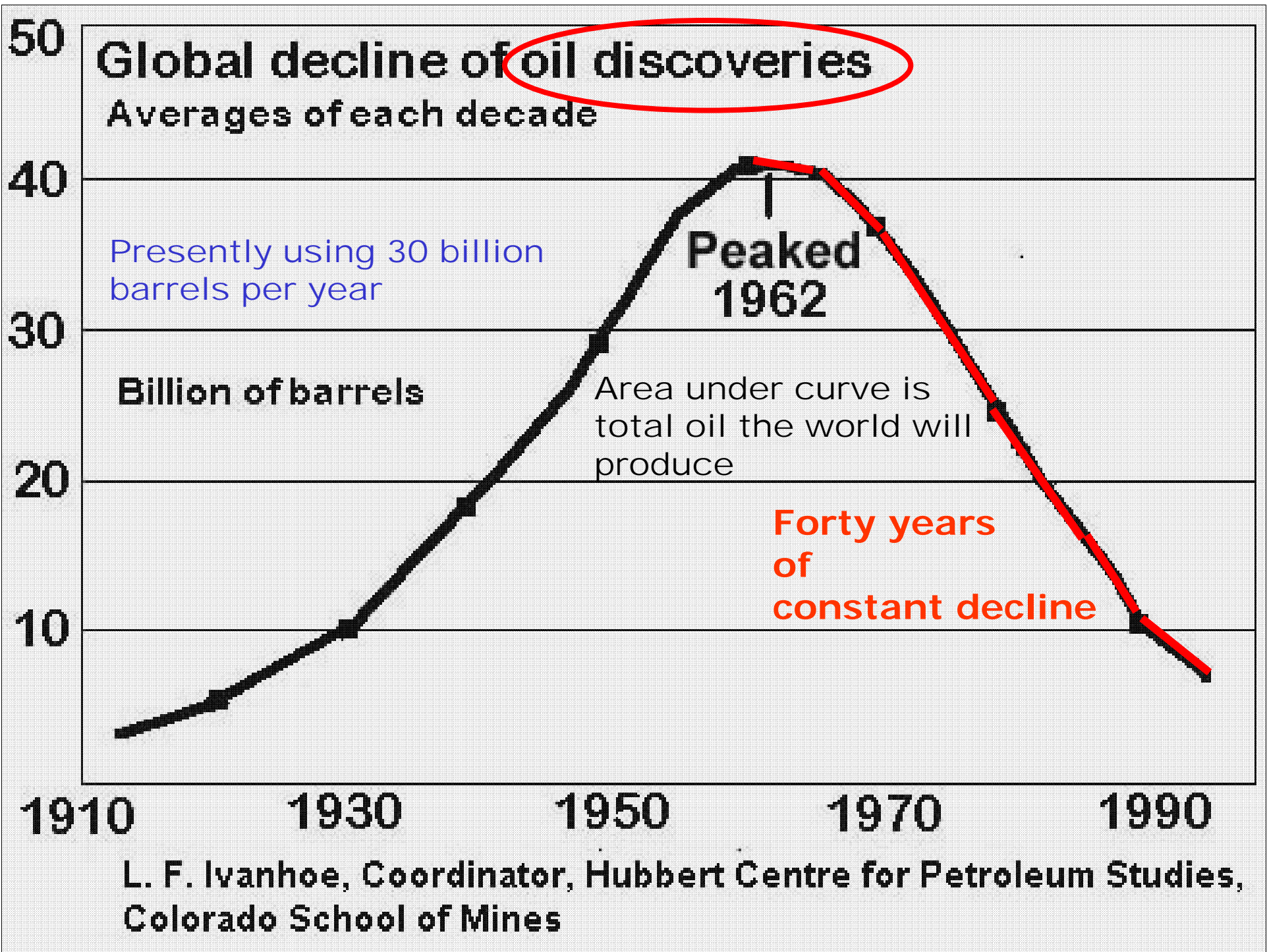
# Finite fossil fuel growth allowed exponential:



# The End of Oil



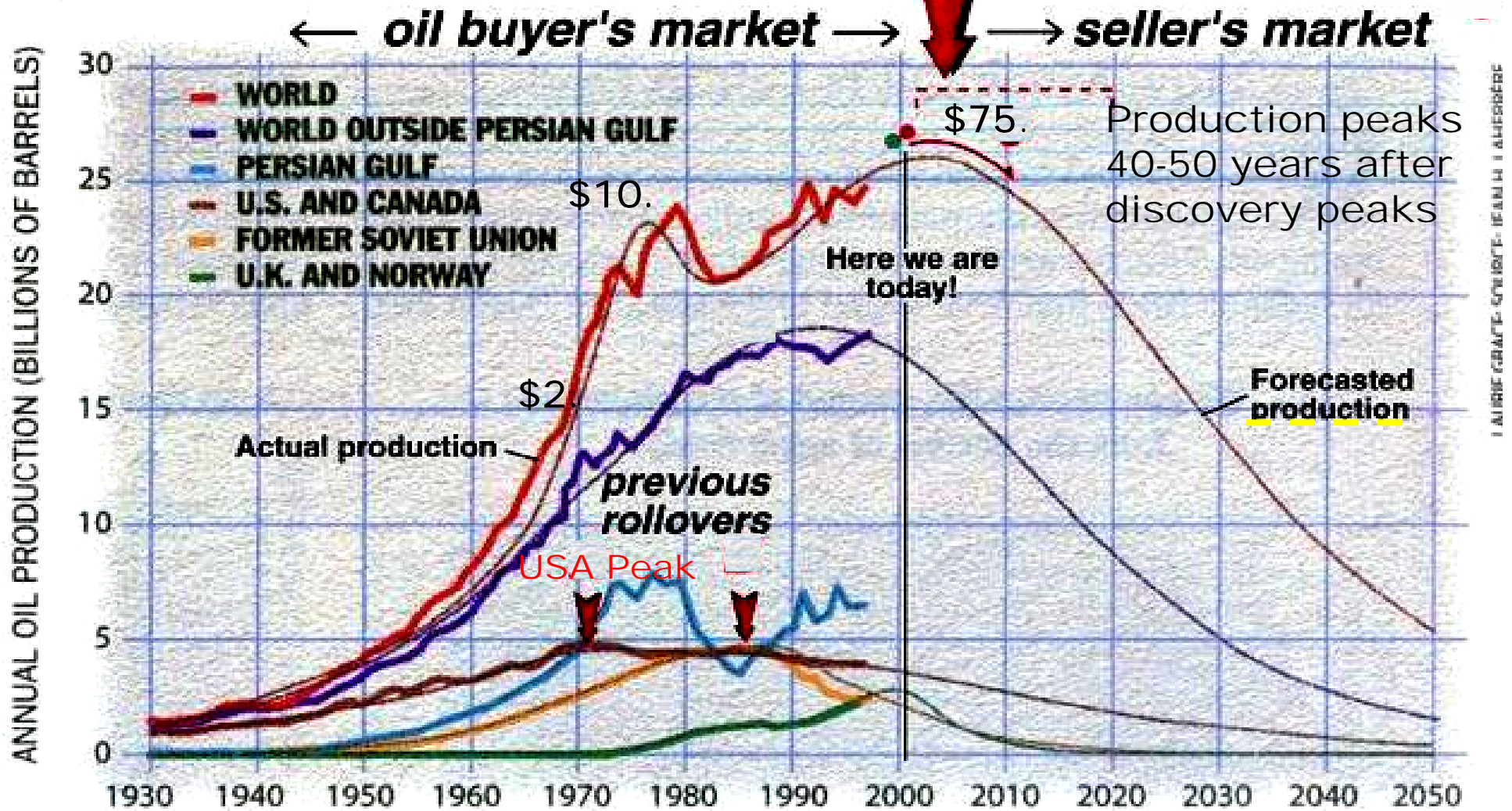
- ▶ N. American natural gas production in decline (23% of US energy)
- ▶ Not enough gas for 150,000+ MW of new USA gas turbines
- ▶ Half the world's oil is almost gone – finite resources peak when half gone
- ▶ World oil production peaking now -10 years, after 140+ years of growth
- ▶ Energy is the **BIGGEST** problem we (humans) have to solve – it effects **EVERYTHING**



# ARE WE RUNNING OUT OF OIL? by L. B. Magoon

**THE BIG ROLLOVER** = Peak Oil

Figure 1

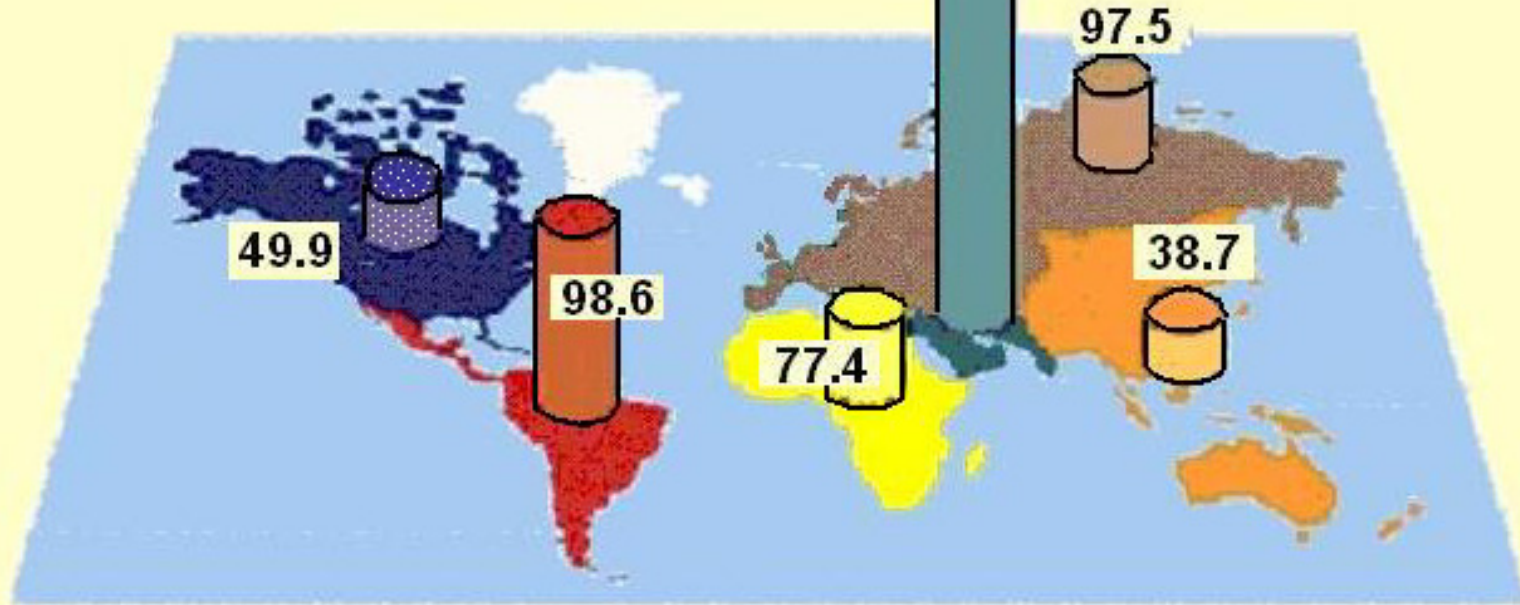
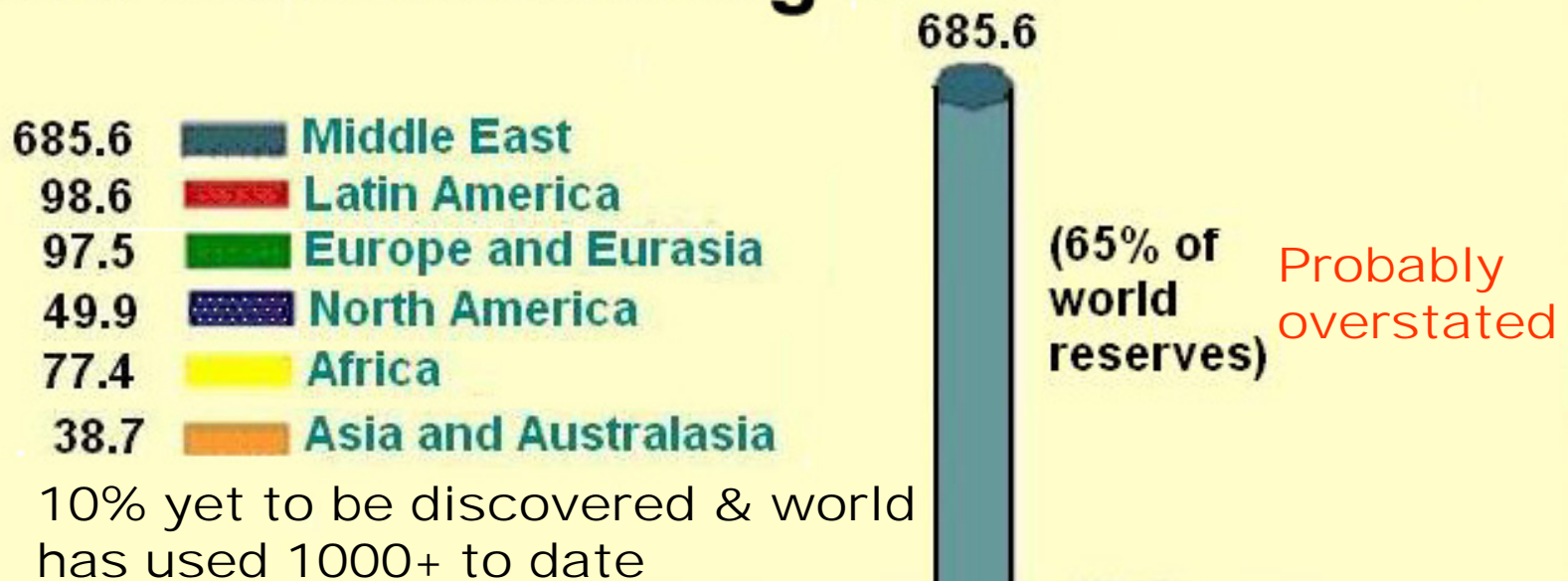


<http://www.hubbertpeak.com/magoon/>

Dr. Les Magoon, USGS petroleum geoscientist

Modified from: Campbell and Laherrere, 1998

# Where the remaining oil is



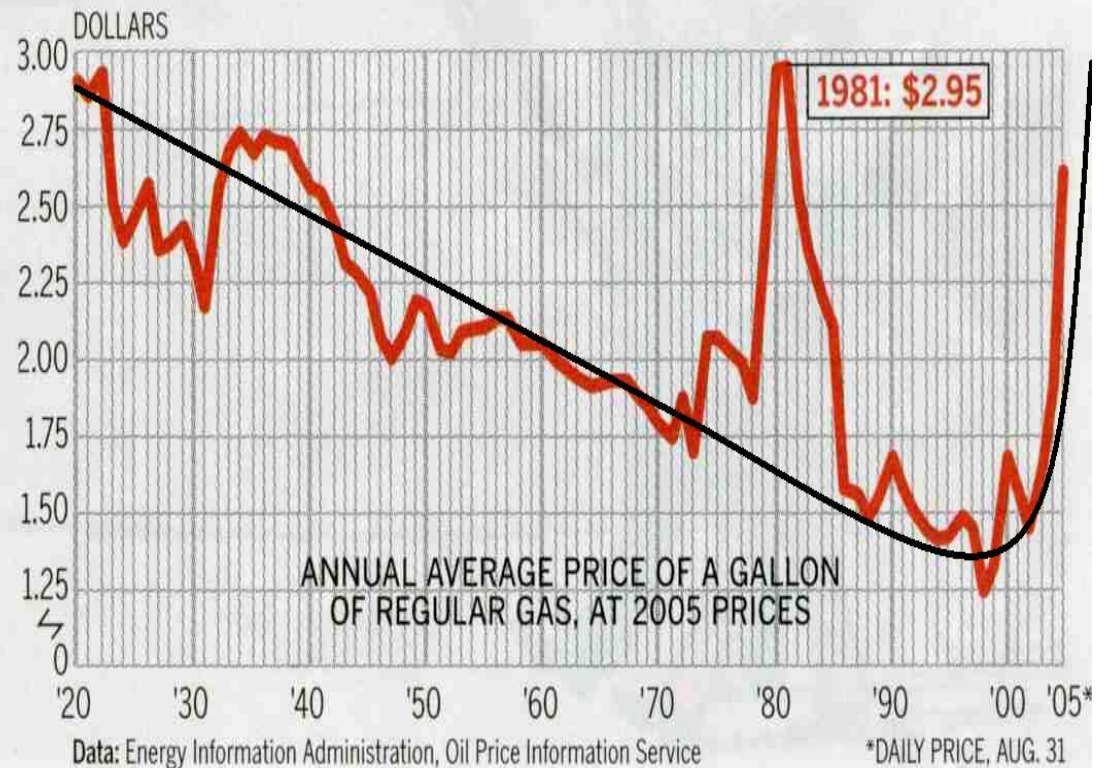
Proven world oil reserves (billions of barrels) BP Statistical Review of World Energy 2002.



Long term oil pricing bottomed ~2000, a 100+ year trend has reversed

## THE BIG PICTURE

**LONG VIEW** With the recent runup, gas prices are now nearing their historic peak

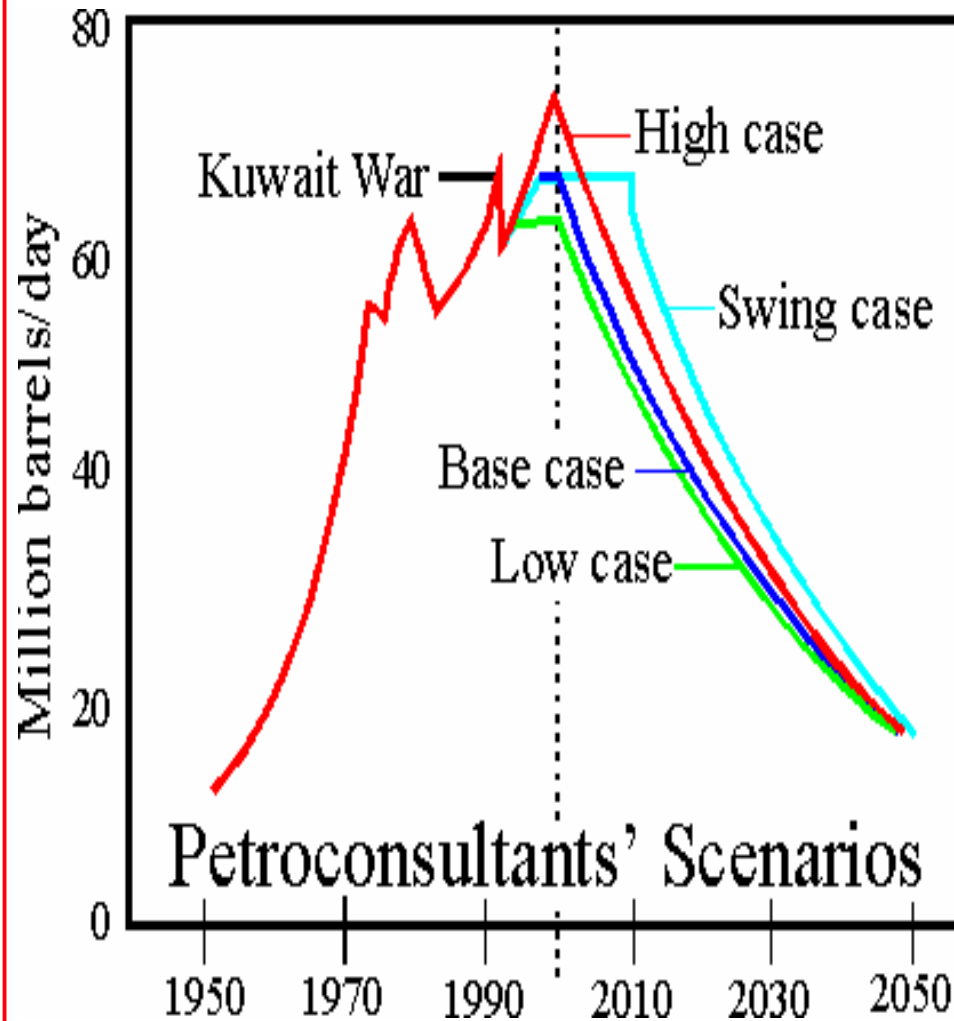


September 12, 2005 | **BusinessWeek** | 13

# Energy Facts

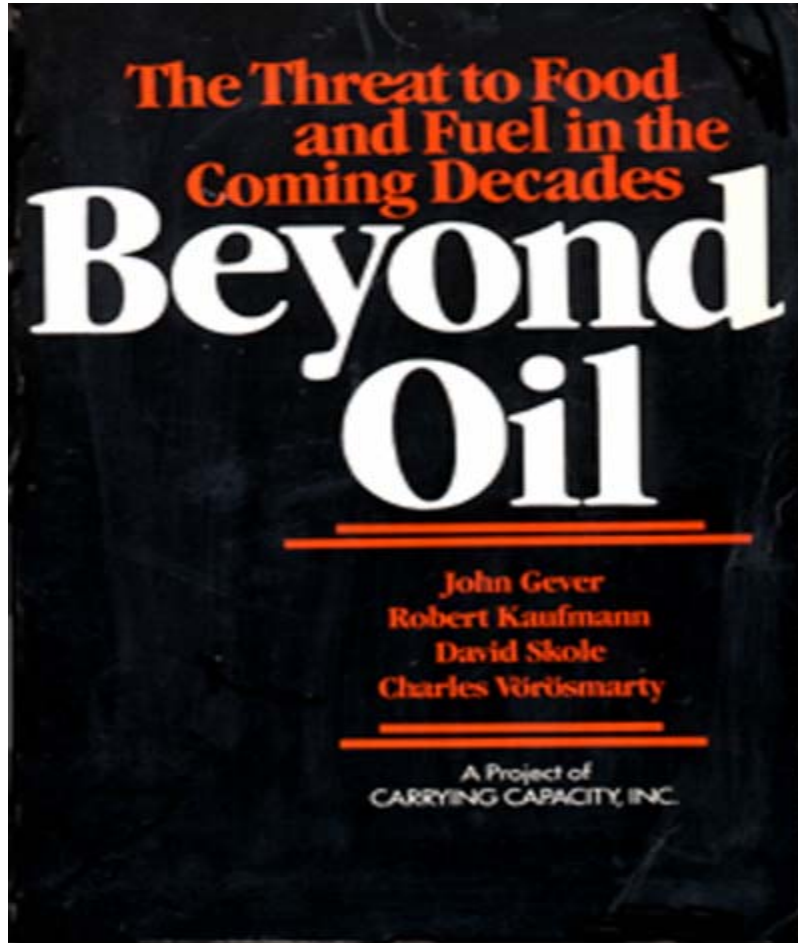
- ▶ 1 barrel of oil = 42 gallons or 672 cups (8 oz bottles)
- ▶ The world today consumes 85 million barrels/day or 31 billion a year. At \$75/barrel = \$2.3 trillion/year or 11 cents per cup
- ▶ Energy supply ~40% oil, ~20% natural gas, ~20% coal, ~10% RE, nuclear
- ▶ Total world energy bill ~ \$8 trillion/year
- ▶ Wind power ~ \$14 billion/year
- ▶ Solar ~ \$7 billion/year
- ▶ Necessary for food, housing, movement-**EVERYTHING**
- ▶ Energy use in USA is 6 times world average – need 6 earths to support 6.4 billion people with our lifestyle
- ▶ Peak Oil is a proven theory (Hubbert)
- ▶ Denial is a proven theory in human behavior
- ▶ Fossil fuels and nuclear are finite, renewables are infinite
- ▶ Continued exponential growth in energy is not possible
- ▶ Energy Returned on Energy Invested (ERoEI) – “Energy Profit” critical for making informed future energy decisions – not just on financial returns

# Why Renewable Energy?



- Fossil fuels are finite, dirty-CO<sub>2</sub>=GLOBAL WARMING!
- Oil is largest energy source for US and world (40%)
- US imports over 65% of the oil we use - 90% by 2025
- North American natural gas supply in decline.
- Most new power plant fueled by natural gas.
- Electricity less than ¼ of energy use but will grow.

# Renewables are:



- Clean, infinite, safe and **secure** (Katrina, Rita)
- Getting **cheaper**
- Fossil fuels are heavily subsidized-getting more **expensive**
- Available in our backyards, most states don't have any NG, oil, uranium or coal
- Solar, Wind, Water, Biomass, Geothermal
- Our **ONLY** long term energy option



# History of Wind Power





# Large Wind Systems

- Range from 100 kW to 4,000 kW (4 MW)

Provide wholesale bulk power at **fixed prices** for 10 – 20 years

Require 15 mph average wind sites or higher

Most in wind farms of 20 MW to 300 MW capacity





# Technology Overview

## ---- Large Wind Projects

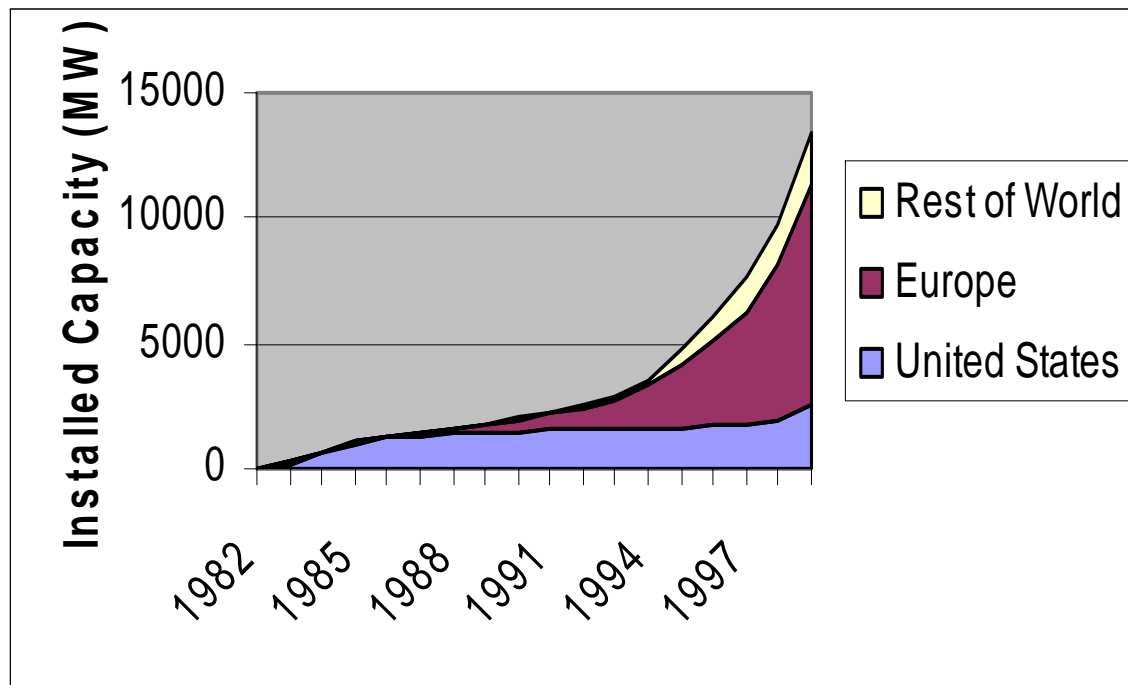
- Projects operating at greater than 35% capacity factors at good wind sites (18 mph average), better than most of Vermont's hydro sites

Produce some electricity 70 - 90% of the time at good wind sites

Over 98 – 99% availability, very reliable

Delivered power at 3 - 7 cents/kWh

# Taking Off Worldwide



Based on information supplied by International Energy Agency.

## Wind Leaders:

1. Germany
2. United States
3. Spain
4. Denmark
5. India

**Total – 30,000 MW  
by end of 2004**



# Small Wind Systems

- Range from 0.3 to 100 kW

Installed in on and off-grid applications

Requires 8 mph or higher average wind sites





# Searsburg, VT – 6 MW



11 Turbines,  
0.55 MW each  
at 2800'

18 mph annual  
average wind  
Speed

6.5 cent power

GMP installed  
in 1997



# Wind Energy in Vermont

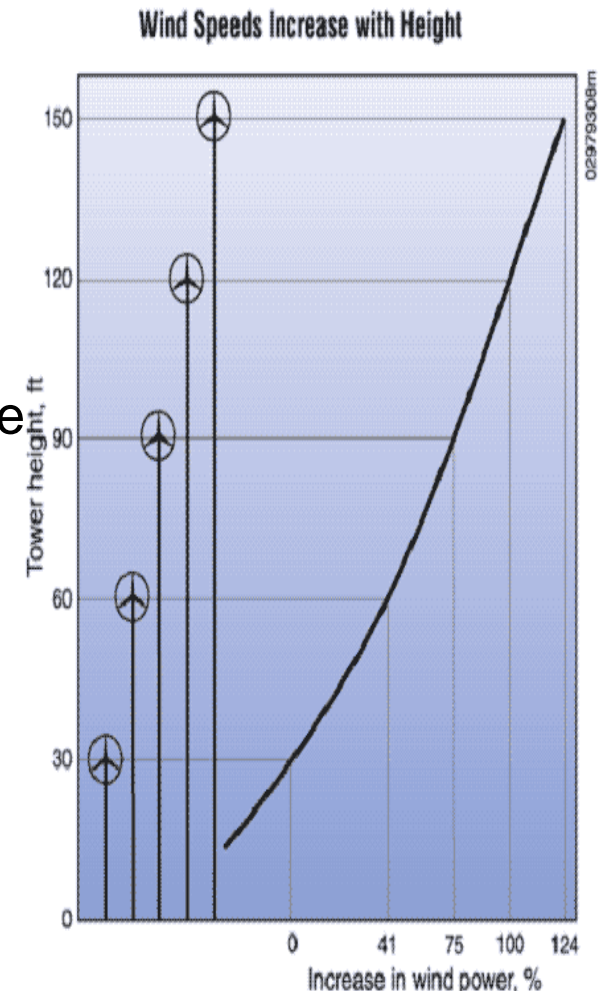
Wind energy is a function of elevation – 3200' sites (20 mph) have 8 times the energy of 200' sites (10 mph) in the Champlain Valley

- Wind farms need 2000' to 3400' sites. Above 3400' icing and fragile environments a problem

Wind farms will be smaller, 10 – 50 MW range  
6000-8000 MW of potential

Turbine size will be 1.5 – 2.5 MW (200' dia. rotors and 200'+ towers). Tower height matters as the wind increases with height

Small wind turbines will be near homes, farms/businesses at lower sites





# Economic Development

- Wind industry is a \$14 billion/year worldwide industry with over 60,000 high paying jobs – growing at 25%/yr.
- A fast growing industry that Vermont can compete worldwide in engineering, components, services, support, small wind
- Huge export potential for components– NRG exports over 60% of sales out of the US and 99.9% out of state. NRG is \$21 million/year, \$100 million by 2012
- Need local market in our backyards if we are serious – present state leadership is lacking - citizens are ahead. In-state renewable generation keeps dollars here. Polls show 70-80% support
- Need strong state policy support - Vermont must back up its **“Green Image”** with real actions. The Vermont “Brand” is in danger since we do not “walk the talk”. New York ahead on renewables.



# We have to choose our energy future

**Renewables** (all are needed but not enough to replace fossil fuels):

- *Wind*: here now, works, cost effective (cheaper than natural gas)
- *Solar*: works, costs coming down
- *Biomass*: limited supply, some pollution, CO2 neutral
- *Geothermal*: part of solution – ground source heat pumping

**Oil** – Supply will peak/decline soon, oil sands/shale-low energy return

**Natural Gas** – supply has peaked in N.A. (LNG is costly, limited)

**Nuclear** – Fuel in finite supply, no waste solution, terrorist targets, can kill millions, major accident every 20 years, CO2 - ¼ of gas

**Coal** – Climate change culprit, finite supply, acid rain, mercury

**Dream fuels:**

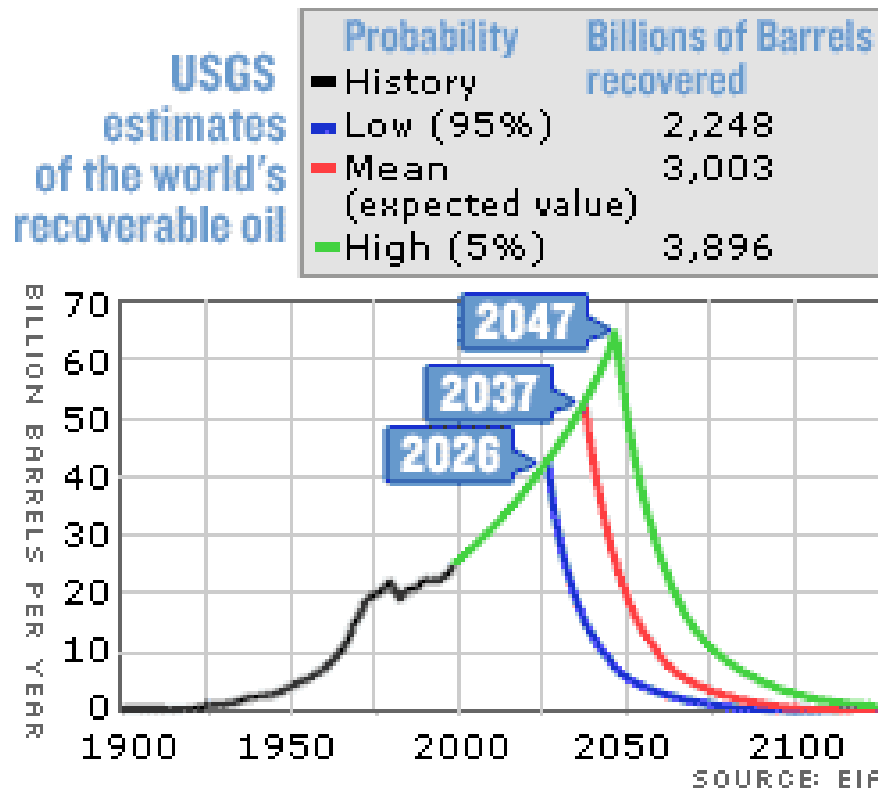
- *Hydrogen*, someday, not a source – needs renewables
- *Fusion*, ?????, not in our lifetime
- *Wishful thinking*, the millions of years of solar energy (fossil fuels) is almost half gone in less than 150 years, can't bet our future on dreams – ENERGY SUICIDE

**Conservation & Efficiency** – Must cut energy use by  $\frac{3}{4}$

# Renewables are our only hope

## EIA PEAK OIL SCENARIOS

These scenarios are based on three different estimates for how much recoverable oil exists in the world, based on government data. The EIA factored in 2% annual oil demand growth, based recent demand trends.



- Fossil fuels are **finite**, dirty
- The era of **CHEAP** fossil fuels is over
- Oil is largest energy source for US and world
- US uses 25% of world's energy but is 4% pop.
- US **had** the 2<sup>nd</sup> largest oil resource in the world
- **EIA is wrong**, oil will peak soon & total recovered oil will be around 2,200 billions barrels.



# Our “Green” Building



75kw Solar PV & 5 kw  
wind turbine – 75%  
of electricity

Day-lighting

GSHP-30 ton  
geothermal cooling

Radiant floor  
heating/cooling

Super energy efficient  
– ¼ use of typical  
46,000 ft<sup>2</sup> building

Wood pellet heat &  
solar hot water

\$12,000/year energy  
bill vs \$80,000. 90+%  
renewable



# Information Sources

[www.awea.org](http://www.awea.org) American Wind Energy Association

[www.REVermont.org](http://www.REVermont.org) Renewable Energy Vermont

• [www.windpower.org](http://www.windpower.org) Danish Windpower

[www.simmonsco-intl.com](http://www.simmonsco-intl.com) Mathew Simmons' speeches

[www.NRGSystems.com](http://www.NRGSystems.com) Wind Measurement & Green Building

[www.EndOfSuburbia.com](http://www.EndOfSuburbia.com) Peak Oil & the Automobile

[www.energybulletin.net/primer.php](http://www.energybulletin.net/primer.php) Primer on Peak Oil

[www.kunstler.com](http://www.kunstler.com) The Long Emergency – New living arrangements