



Rules of Thumb

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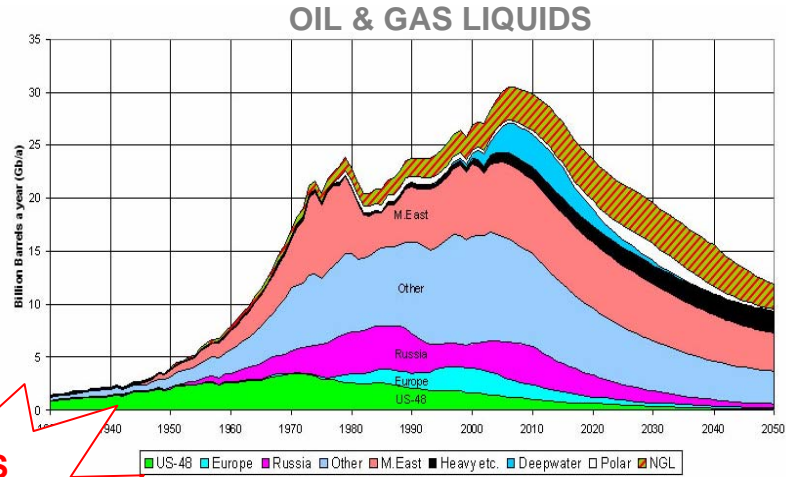
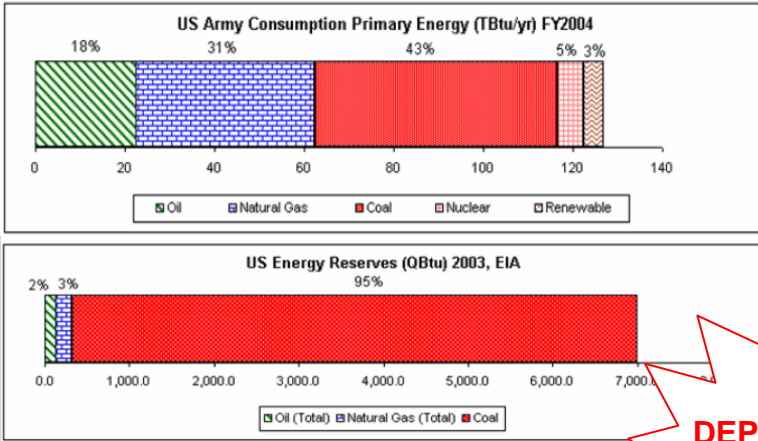


Challenges To Managing The Future

- ✓ World population growing: 2006 = 6.5 Billion, by 2030 estimate is 7.9 Billion
- ✓ World oil demand up since 2000: Up 7 million barrels per day (mbd), 2 mbd increase in China, 1.4 mbd increase in India.
- ✓ Hurricanes Katrina and Rita shut down 27% of US oil refining capacity, production is still off 400,000 barrels per day.
- ✓ US oil imports increasing: 33% in 1973, 58% in 2005, 70% by 2020.
- ✓ US LNG (liquid natural gas) imports increasing: 3% in 2005, 25% in 2020.
- ✓ In 1973 North America consumed twice as much oil as Asia. In 2005 Asian consumption exceeded that in North America
- ✓ US oil consumption up: 20.7 mbd in 2004, 21.1 mbd in 2005.

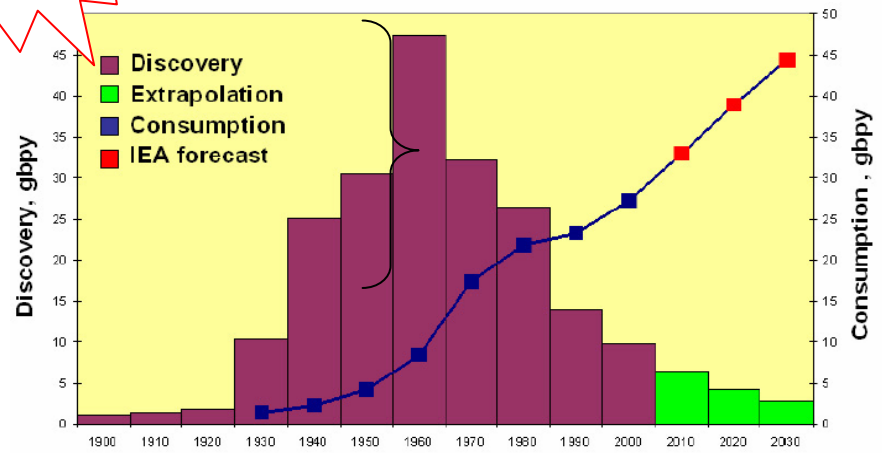


World Energy Situation



US IS DEPENDENT ON FOREIGN OIL

Comparison between discovery and consumption



DOD Energy

LOOMING FUEL CRUNCH
 RISING PRICES
 INCREASING USE
 NO FEDERAL INVESTMENT PROGRAM

} Disaster



Oil Field Forecasts

Projected Oil Production Peak Year by Oil Expert

Peak Year	Oil Expert
2006-2007	A.M. Samsam Bakhitari
2007-2009	Matthew R. Simmons
After 2007	Chris Skrebowski
Before 2009	Kenneth S. Deffeyes
Before 2010	David Goodstein
Around 2010	Colin J. Campbell
After 2010	World Energy Council
2010-2020	Jean H. Laherrere
2016	Energy Information Administration Nominal Case
After 2020	Cambridge Energy Research Associates
2025 or later	Shell
No visible Peak	Michael C. Lynch

Source: Hirsch, Robert et al. February 2005. Peaking of World Oil Production: Impacts, Mitigation and Risk Management. Prepared for the US Dept of Energy

Big Gushers: Projected output of world's top oil fields, in million barrels of oil and natural gas liquids produced daily

Oil Field	Country	2007	2010	% Chg
Ghawar	Saudi Arabia	5.6	5.0	-10.7
Cantarell	Mexico	1.7	1.2	-30.3
North & South Rumaila	Iraq	1.3	1.3	0.0
Greater Burgan	Kuwait	1.2	1.3	1.5
Safaniyah	Saudi Arabia	1.2	1.3	12.5
Sonatrach Oper. Fields	Algeria	1.1	0.9	-13.5
Daqing Fields	China	0.8	0.7	-12.9
Gachsaran	Iran	0.7	0.7	0.0
Ahwaz Asmari	Iran	0.6	0.5	-14.2
Azeri Chirag Guneshli	Azerbaijan	0.6	1.2	72.6
Samotlorskoye	Russia	0.6	0.6	0.0
Bu Hasa	United Arab Emirates	0.5	0.7	32.7
Ku-Maloob-Zaap	Mexico	0.5	0.7	42.8
Northern Fields	Kuwait	0.5	0.8	44.4
Upper Zakum	United Arab Emirates	0.5	0.6	10.7
	Rest of world	69.9	77.3	10.5

Source: Wood Mackenzie



Oil Experts: Contrasting Peak Theories

Pessimists	Optimists
There is a growing disparity between increasing production (dues to increasing demand) and declining discoveries of new oil reservoirs.	Heavy investment in new discovery, new technology and refining capacity will increase supply.
OPEC countries are producing at near 100% capacity; spare capacity is almost nonexistent. Supply and demand are almost equally	Advanced recovery technologies will extend the lives of oil reservoirs. Technology will increase supply and decrease demand.
matched Consumption levels are increasing alarmingly, at an unsustainable rate given the amount of oil currently estimated to be in the ground.	Non-traditional oil sources, such as oil shale, tar sands and heavy crude, are now more marketable due to advances in technology, and
Oil reserves data is an estimated guess at best and is unaudited. Many countries have cause to over-inflate reserve estimates in order to increase profit share.	Oil reserves data is an estimated guess at best, and can therefore not be used to determine when oil will peak.
No alternative energy source yet exists to take the place of oil.	Market forces will ensure that by the time oil peaks, viable alternative energy sources will be
Oil has already peaked or will peak before 2010, and, without mitigation, the global consequences will be severe.	Oil will not peak until after 2025, and the transition from oil to alternative sources will be smooth.



FIVE GOALS OF ENERGY STRATEGY - 25 YEAR PLAN

- Eliminate energy waste in existing facilities;
- Increase energy efficiency in new construction/renovations;
- Reduce dependence on fossil fuels;
- Conserve water resources; and
- Improve energy security.



What Can We Do Long Term?

- ✓ Energy efficient renovation & new construction
- ✓ Energy conservation retrofit projects
 - alternative financing
 - direct appropriations
- ✓ Purchase/ Invest in Renewable Energy
 - Solar Thermal
 - Photovoltaic
 - Wind, Geothermal
 - Biomass
- ✓ Privatize/ Modernize Utility Systems



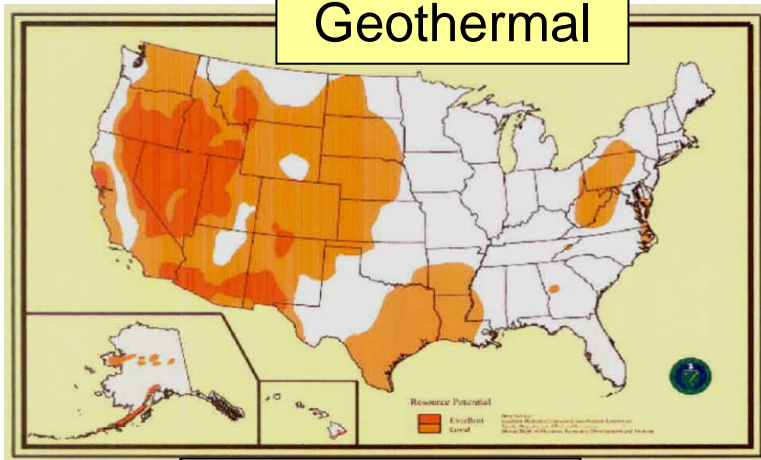


Renewable Resources

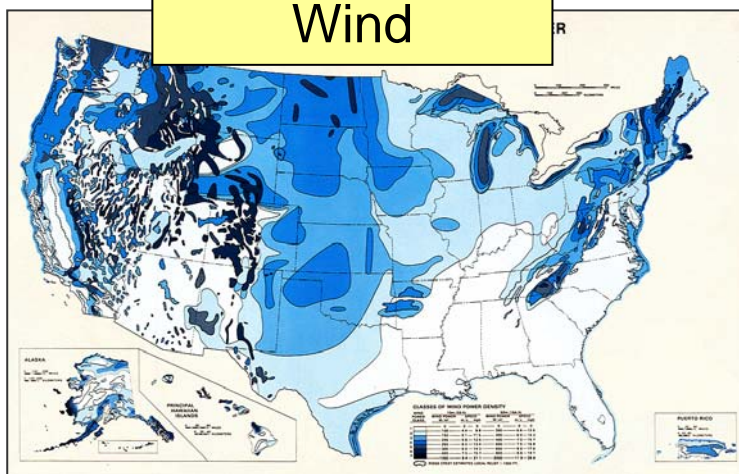
National Renewable Energy Lab

<http://www.nrel.gov/gis/>

Geothermal

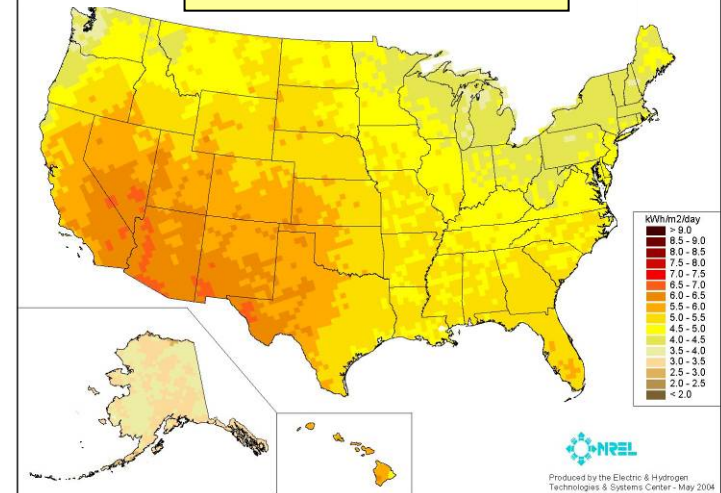


Wind

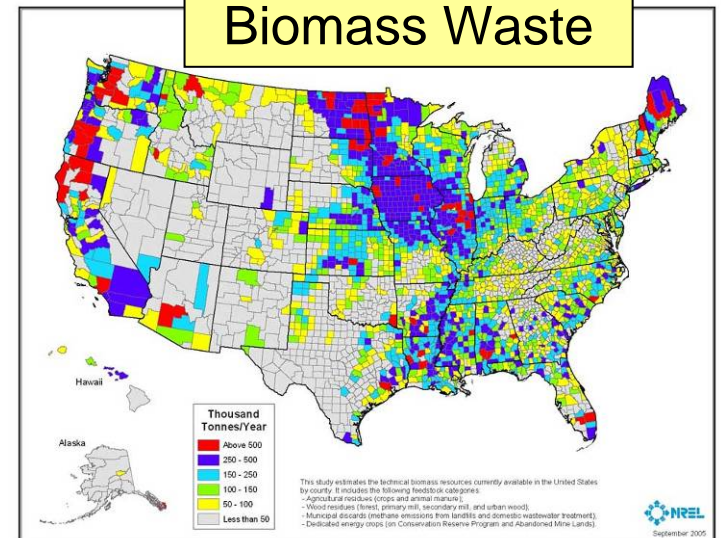


Solar

Annual



Biomass Waste





Renewables





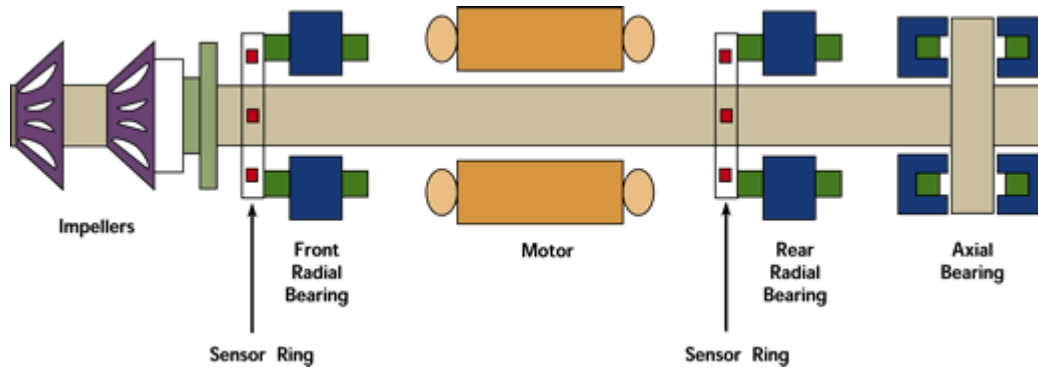
ALTERNATIVE FUELS

- **B20 Biodiesel - blends available up to 100%**
- **E85 Ethanol - blends up to 100%**
- **Fischer Trope Fuels – Liquefied Coal**
- **Algae to Fuel**





Magnetic Bearings





What are the four variables in Utility Cost Control?

- 1) How long does it run?
- 2) How many are running?
- 3) How efficient is it running?
- 4) How much does it cost to run?



What Should we be doing now?

LOW COST ENERGY CONSERVATION RULES OF THUMB

- Programmable Thermostats – 1-4 year payback
- Lighting (Indoors and Outdoors) – 1-5 year payback
- Controls on 24/7 operating equipment (HVAC, DHW pumps, exhaust fans) – 3-8 year paybacks
- Maintenance Issues (filters, insulation, manual mode) – 1-9 year payback



What Can You do RIGHT NOW

- Use programmable thermostats that automatically increase temperature set points in the summer and reduce them in the winter. Use 82-85 F in the summer and 57-60 F in the winter. Occupied at 70-74 F.
- Turning off all computer equipment every night. Updates can automatically download when you push the shut down button and updates occur prior to completing shut down.
- Turn off your lights every time you leave a room as the last person even for one second.
- Point out to supervisors, instructors, and maintenance folks when you see outside lighting on during the day.
- Do not leave fans, pumps, radios, battery chargers, charging transformers, exhaust fans, coffee pots, any appliance or equipment running when no one is using them.

Beware of low
flying aircraft

OUTDOOR SYSTEMS



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then energy link