

ENERGY: THEN, NOW, AND IN THE FUTURE - REVISITED

PREPARED BY - GUNTERMANN ENGINEERING
600 PROSPECT ST - #A7
NEW HAVEN, CT 06511

PREPARED FOR – ASHRAE- CT CHAPTER
NOVEMBER 13, 2008

BACKGROUND

I HAVE EXPERIENCED FIRST HAND AS AN ACTIVE PARTICIPANT IN ALL THREE ENERGY CRISES AND HAVE A PUBLISHED RECORD WHICH HAS BEEN VERY ACCURATE.

- IN THE 1973/1974 ENERGY CRISIS.
- IN THE 1978/1979 ENERGY CRISIS.
- IN THE CURRENT ENERGY CRISIS.

The State of ENERGY: THEN, NOW, AND IN THE FUTURE

- <C:\Documents and Settings\Alfred Guntermann\My Documents\My Web Sites\guntermann engineering3\images\The State of Energy>

WHAT VOTERS WANT – EVERYTHING!!

RESULTS OF A RECENT POLL IN WALL STREET JOURNAL

1. DEVELOP ALTERNATE ENERGY. – 73%.
2. BUILD MORE FUEL EFFICIENT CARS – 67%.
3. BUILD MORE REFINERIES – 50%.
4. EXPAND OFFSHORE DRILLING – 45%.
5. BUILD MORE NUCLEAR POWER PLANTS – 40%.
6. OPEN PROTECTED AREAS IN ALASKA – 38%.
7. ENCOURAGE CONSERVATION – 35%.
8. TAX OIL COMPANIES – 30%.
9. RELEASE SOME OF SPR – 20%.
10. HAVE A GAS TAX HOLIDAY – 18%.

NATIONAL ENERGY POLICY

- THE LAST 35 YEARS WE HAVE HAD A “FREE MARKET” APPROACH BASED ON INCREASING ENERGY SUPPLIES. IT HAS FAILED BADLY.
- OBAMA NATIONAL ENERGY POLICY – BETTER WITH MORE GOVERNMENT INVOLVEMENT, BUT MISS-DIRECTION IN KEY AREAS AND SHORT COMINGS IN OTHERS.
- NEED FOR A MASSIVE ENERGY CONSERVATION PROGRAM.

ENERGY CRISIS PROBLEM AREAS

- US TRADE DEFICIT.
- SUFFICIENT ENERGY FOR DEVELOPING WORLDS GROWTH.
- GLOBAL WARMING.
- STAGFLATION – SIMULTANEOUS INFLATION & RECESSION.
- WORLD PEACE AND SECURITY.

U.S. TRADE DEFICIT

1. 2006 U.S. TRADE DEFICIT - \$252 BILLION, 31%
2. 2007 U.S. TRADE DEFICIT - \$293 BILLION, 35%
3. 2008 U.S. TRADE DEFICIT –
 - a. 1ST FOUR MOUNTS – AT 47% WITH \$100/BBL OIL
 - b. PLUS \$240 BILLION AT \$120/BBL
 - c. PLUS \$320 BILLION AT \$140/BBL
4. COULD RESULT IN \$10 TO \$20 TRILLION TRADE DEFICIT OVER 10 YEARS AND TRANSFER 25% TO 50% OF US WEALTH TO OIL PRODUCING COMPANYS.
5. REQUIRES SHORT TERM SOLUTIONS.

U.S. ENERGY CONSUMPTION

2006 TOTAL U.S. ENERGY CONSUMPTION – 99.5 QUADS -
TRANSPORTATION – 28. QUADS

- RESIDENTIAL – 22.25 QUADS
- COMMERCIAL – 17.9 QUADS
- INDUSTRIAL – 33.3 QUADS

NON-TRANSPORTATION TOTAL – 73.5 QUADS –
ELECTRICAL PORTION OF NON-TRANSPORTATION

- ELECTRICAL END USE – 12.48 QUADS
- ELECTRICAL LOSSES – 27.2 QUADS

U.S. ENERGY COMPARISON

- U.S. CONSUMPTION – 25% WITH 4% OF WORLDS POPULATION.
- EUROPE HAS APPROXIMATLY THE SAME POPLULATION AND GNP AS U.S. BUT HAS HALF THE U.S. ENERGY CONSUMPTION.
- WE SHOULD BE ABLE TO CUT OUR CONSUMPTION IN HALF.
- REQUIRES GOVERNMENT LEADERSHIP

ENERGY CONSERVATION SOLUTION

- SHORT TERM SOLUTION.
- BUYS TIME TO DO RESEARCH AND DEVELOPMENT ON OTHER ALTERNATES.
- REDUCES SIZE AND COST OF REPLACING EXISTING ENERGY SOURCES.
- REDUCES ABILITY OF FOREIGN COUNTRIES TO BUY U.S. ASSETS.
- REDUCES AMOUNT OF U.S. DEBT AND SALE TO FOREIGN COUNTRIES.

MASSIVE U.S. ENERGY CONSERVATION PROGRAM

- RESIDENTIAL
- COMMERCIAL
- INDUSTRIAL
- POWER PLANTS
- TRANSPORTATION

RESIDENTIAL ENERGY CONSERVATION

RETROFIT ALL EXISTING RESIDENTIAL HOMES
WITHIN 10 YEARS.

- BLOW INSULATION INTO WALLS AND ADD ROOF INSULATION.
- INFILTRATION.
- WINDOWS.
- ENERGY EFFICIENT LIGHTING.
- NEW HEATING, DOMESTIC HOT WATER AND AIR CODITIONING SYSTEMS.

OBAMA RESIDENTIAL ENERGY PLAN

- WEATHERIZE 1 MILLION LOW INCOME HOMES A YEAR – 28 MILLIONS EXISTING LOW INCOME HOMES.
- RECOMMENDATION – INCREASE TO 4 MILLION LOW INCOME HOMES A YEAR.
- RECOMMENDATION - PROVIDE SIGNIFICANT INCENTIVES TO RETROFIT ALL MIDDLE AND UPPER INCOME HOMES WITHIN 10 YEARS.

OBAMA COMMERCIAL ENERGY PLAN

- GOAL IS TO IMPROVE NEW BUILDING STANDARDS BY 50%.
- THIS CAN BE MANDATED THROUGH NEW CODES.
- GOAL IS TO IMPROVE EXISTING BUILDING STANDARDS BY 25% OVER THE NEXT DECADE.
- RECOMMEND - GOAL BE INCREASED TO INCREASE EXISTING EFFICIENCY BY 50%.
- RECOMMEND - INCENTIVES BE PROVIDED.

OBAMA INDUSTRIAL ENERGY PLAN

- DOES NOT ADDRESS
- RECOMMEND THAT LARGE INCENTIVES ARE PROVIDED TO REDUCE INDUSTRIAL ENERGY CONSUMPTION BY 50% IN 10 YEARS.

OBAMA ELECTRIC GENERATION PLAN

REQUIRES 10% ELECTRICITY BY 2010 AND 25% BY 2025

- RECOMMEND - PROVIDE INCENTIVES FOR NEW CO-GENERATION POWER PLANTS FOR LARGE SYSTEMS.
- RECOMMEND - PROVIDE INCENTIVES FOR MICRO-TURBINES AND FUEL CELLS.
- RECOMMEND - PROVIDE INCENTIVES TO EXISTING OIL AND COAL FIRED POWER PLANTS 31% EFFICIENT WITH NEW 68% EFFICIENT COMBINED CYCLE GAS POWER PLANTS.

ENERGY CONSERVATION INCENTIVES

MASSIVE FEDERAL ENERGY CONSERVATION PROGRAM WITH INCENTIVIES THAT ARE SUFFICIENT TO RETROFIT ALL BUILDINGS IN 10 YEARS.

- TAX CREDITS.
- ENERGY TAXES.
- GOVERNMENT SUPPORT PROGRAMS.
- ENERGY RETROFIT LOANS.
- LONG TERM FINANCING.
- ACCELERATED DEPRECIATION.

SOLAR ENERGY

- OBAMA ENERGY PLAN – HAVE UTILITIES PROVIDE 10% RENEWABLE ENERGY BY 2012 AND 25% BY 2025. SEVERAL STATES ALREADY HAVE SIMILAR PROGRAMS. REQUIRES UTILITIES TO PROVIDE RENEWABLE ENERGY SYSTEMS AND THEN PASSES THE COSTS ON TO ALL RATE PAYERS.
- CONNECTICUT HAS SOME OF THE HIGHEST SOLAR ENERGY INCENTIVES IN THE COUNTRY.
- RECOMMENDATION – DELETE MANDATES AND REDUCE FEDERAL AND STATE INCENTIVES.

PHOTOVOLTAIC SOLAR ENERGY

SOLAR PHOTOVOLTAIC ELECTRIC COST ANALYSIS

New Haven, CT

Existing Annual kWh	9,996 kWh
Solar kWh savings (50%)	4,998 kWh
Average Electric rate	\$.1661/kWh
Installed Peak Watts	3,980 W
Roof area needed	398 SF
Installed cost @ \$9/watt	\$35,820
Financed Gross Payment/yr	\$ 2,688
Fed Tax credit	\$ 2,000
CT state rebate	\$16,200
Net Cost	\$17,700
Financed Net Payment/yr	\$ 1,344/yr.
Solar Rating	4.6 kWh/SM/day
Gross Energy Saved	4,998kWh
Energy Delivered @ 86.7% efficiency	4,333kWh
Annual \$ saving	\$ 725 1 st year
Ave. Annual \$ saving	\$ 1,212/yr
25 th year energy savings	\$ 1,699/yr
25 year lifetime saving	\$30,422

PV SOLAR CASH FLOW

- ..\Desktop\Energy Cash Flow Analysis
30yearsTaxesSolarA.doc

PV SOLAR UTILIZATION RATE

- UTILIZATION RATE IS $4,998 \text{ kWh} / 4 \text{ kW} = 1,250$ FULL LOAD HRS / YEAR OR 14.5% PER YEAR.
- 4 kW OF NUCLEAR POWER AT 91.5% UTILIZATION RATE WOULD GENERATE 32,062 kWh PER YEAR.
- ESTIMATED COST FOR 4 kW NUCLEAR at \$6,000 PER KW = \$24,000.
- ESTIMATED SIZE FOR TO PRODUCE 32,062 kWh/year would be $(91.5\%/14.5\%)*4 \text{ kW} = 24.5 \text{ kW}$.
- ESTIMATED COST FOR 24.5kW SOLAR ATED COST FOR 24.5 kW at \$9,000 / kW would be \$227,172.

SOLAR ENERGY COST

- THE ELECTRIC RATE PAYERS AND TAX PAYERS WILL HAVE TO PAY THE DIFFERENCE BETWEEN \$227,172 AND \$24,000 IN HIGHER AVERAGE ELECTRIC RATES.

PV SOLAR HIDDEN COSTS

- BACK UP ELECTRIC GENERATION.
- PV LOSSES – AVERAGE 75%.
 - A. INVERTER LOSSES – 15%.
 - B. WIRING, SWITCHGEAR LOSSES – 10%
 - C. GLASS COVER – AVERAGE 10% OVER LIFE.
INCLUDES REFLECTANCE, DIRT, ABRASION.

PV SOLAR LIFE EXPECTANCY

PV SOLAR SYSTEM LIFE EXPECTANCY – NO EXPERIENCE.

- ENCLOSURE TO WITHSTAND 120 MPH WIND GUSTS AND 1" HAIL.
- INVERTER LIFE IS 10 YEARS.
- PV SOLAR CELLS MAY DELAMINATE OVER TIME
- MOISTURE MAY LEAK INTO ENCLOSURE
- DECAY FROM ULTRA VIOLET RAYS
- FAILURE DUE TO CYCLIC TEMPERATURE EXTREMES

SOLAR GRAND PLAN

- ARTICLE IN SCIENTIFIC AMERICAN IN JAN 2008
- PROVIDE 2,930 GW OF THIN FILM PV SOLAR IN SW DESERT BY 2050 TO PROVIDE 65% ELECTRICITY.
- ASSUMES PV COSTS TO BE REDUCED FROM \$4/W TO \$1.20/W BY 2050.
- ASSUMES EFFICIENCY IMPROVES FROM 10% TO 14%.
- REQUIRES 30,000 SQUARE MILES.
- ASSUMES COMPRESSED AIR STORAGE.
- ASSUMES HVDC POWER TRANSMISSION LINES TO TRANSPORT POWER FROM SW TO EAST.

SOLAR GRAND PLAN COST

- AT \$9,000/kW – THE 2,940 GW WOULD COST \$26.5 TRILLION IN TODAY'S DOLLARS.
- WITH A 50% TAX CREDIT, THE COST TO TAX PAYERS WOULD \$13.3 TRILLION, OR IT WOULD BE PAST ON TO RATE PAYERS WITH HIGHER UTILITY RATES.

SOLAR ENERGY LIMITATIONS

- SOLAR AVAILABILITY – SUNLIGHT IS DILUTE AND IRREGULAR.
- SOLAR EFFICIENCY – THERE ARE MAXIMUM THEORETICAL EFFICIENCY LIMITS. FUTURE TECHNOLOGY LIMITATIONS.
- SOLAR MATERIAL AND ENERGY REQUIREMENTS – SOLAR ENERGY PRODUCTION IS MATERIAL AND ENERGY INTENSIVE. WILL KEEP SOLAR COSTS FROM DECREASING.

SOLAR AVAILABILITY

SOLAR IRRADIATION HOURLY AND DAILY VALUES FOR 40 DEG NOR

Number						Btu/h-sqft Total Irradiation on South Facing Surface at 40 deg Ang Connecticut – 1982 ASHRAE Application Handbook – Solar Energy							
AM	PM	21-Jan	21-Feb	21-Mar	21-Apr	21-May	21-Jun	21-Jul	21-Aug	21-Sep	21-Oct	21-Nov	21-Dec
1	5	0	0	0	0	0	3	0	0	0	0	0	0
2	6	0	0	0	8	15	18	17	9	0	0	0	0
3	7	0	21	55	70	76	77	75	69	51	15	0	0
4	8	74	122	141	145	144	142	142	141	134	113	72	45
5	9	171	205	217	213	206	202	203	207	208	195	167	152
6	10	237	267	276	267	255	248	251	259	265	257	233	221
7	11	277	306	313	301	287	278	281	292	301	295	273	262
8	12	291	319	326	313	297	289	292	303	313	308	287	275
	Surface Daily Totals	1818	2162	2330	2320	2264	2224	2230	2258	2228	2060	1778	1643
11	Direct Normal Irrad.	2182	2640`	2916	3092	3160	3180	3062	2916	2708	2454	2128	1978

SOLAR RADIATION – 3 LOCATIONS

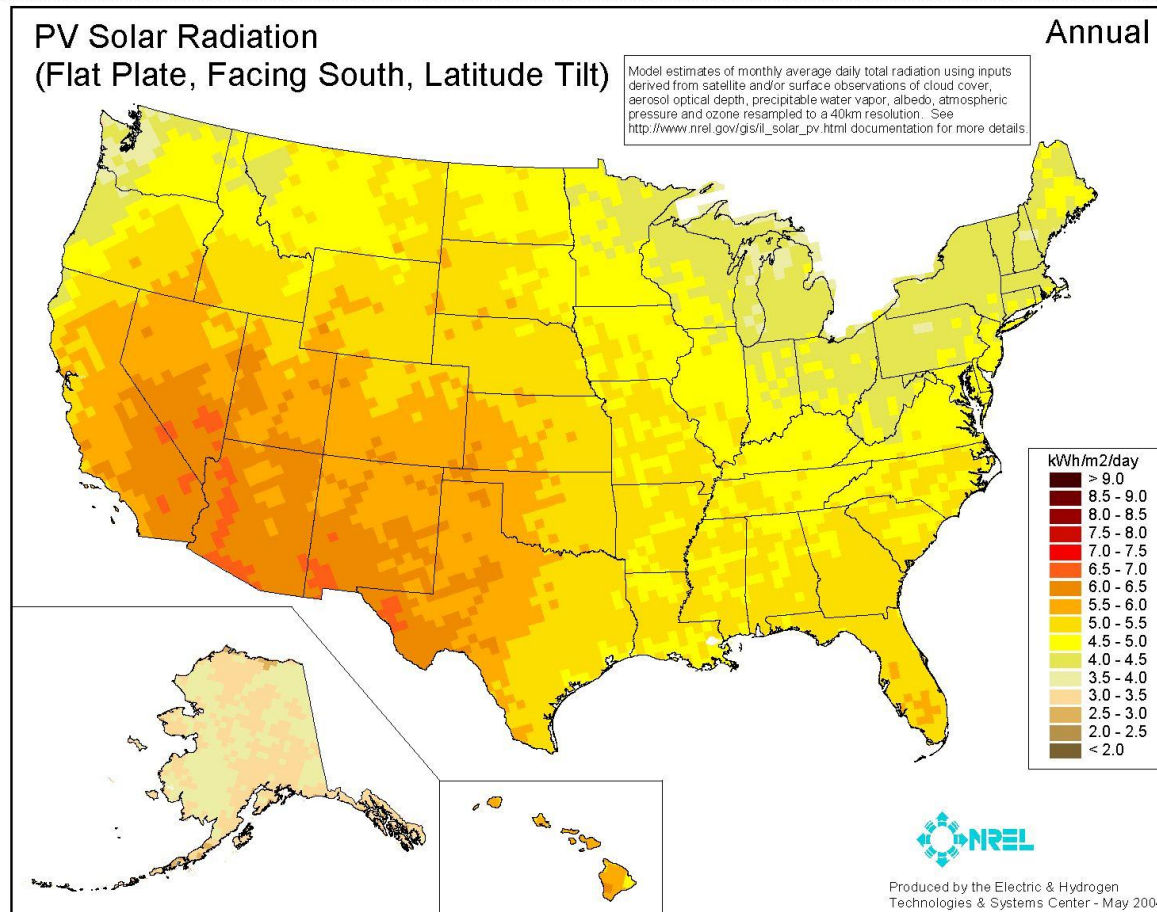
- **SUMMARY OF SOLAR IRRADIATION HOURLY AND DAILY VALUES**
- **FOR 32 AND 40 DEGREE NORTH LATITUDE**

	Connecticut	Ohio	New Mexico
Annual Gross Solar HG (Btuh/SF/yr) ¹	768,698 ¹	768,698 ¹	803,718 ²
No. Days/year	365	365	365
No. Cloudy Days/year ³	161.4	186.4	82.5
No. Partly Cloudy Days/year ⁴	93.4	95.9	87.4
No. Solar Heat Gain Days/year ⁵	159.6	130.7	238.7
Annual Net Solar HG (Btuh/SF/yr) ⁶	331,022	278,558	527,139
Savings 60% eff. collector (Btuh/SF/yr)	198,613	167,135	316,283
Max Oil saved Gal/SF/yr (140,000Btu/gal)	1.4	1.2	2.2

Notes:

- The annual gross solar heat gain from 1982 ASHRAE Handbook, Chapter ? 40 degrees North Latitude.
- Ditto, 32 degree North Latitude
- U.S. Climate Atlas
- U.S. Climate Atlas
- The No. of Solar HG Days/yr is the No. Days/year less (No. Cloudy Days/yr plus ½ No. Partly Cloudy Days/yr).
- The Annual Net Solar HG is the Annual Gross Solar HG multiplied by the ratio of the No. Solar HG Days/yr and the No. Days per year.

ANNUAL US SOLAR RADIATION



SOLAR EFFICIENCY

RESEARCH WORK BY SHOCKLEY AND QUEISSER
FOUND MAXIMUM THEORETICAL
“THERMODYNAMIC EFFICIENCY LIMITS” FOR PV

TYPE	CURRENT AVERAGE	CURRENT TOP	CURRENT LAB BEST	THEORETICAL LIMIT
SINGLE CRYSTAL SILICON SOLAR	15%	18%	25%	31%
THIN FILM SOLAR CELL	7%-8%	10%	16.5%	
CONCENTRATING SOLAR CELL				41%
MULTIJUNCTION SOLAR CELL				66%

SOLAR MATERIAL & ENERGY REQUIREMENTS

- MATERIALS WERE EVALUATED BY DEPT. OF ENERGY – “ENERGY EFFICIENCY AND RENEWABLE ENERGY”. PROJECTED MATERIAL DEMAND TO ADD 20GW/100GW ANNUAL WORLD PRODUCTION CAPACITY TO PROVIDE ACCUMULATED 2,000 GW BY YEAR 2050 . MUST CONSIDER WORLD MATERIAL PRODUCTION AND DEMAND. NOTE U.S. ETHANOL PRODUCTION CAUSED CORN SHORTAGE AND QUADRUPLING PRICES.

U.S. AND WORLD GENERATING CAPACITY AND POWER PRODUCTION

- EIA's 2008's World Energy Outlook lists the Total US and World Installed Generating Capacity (GW) and Annual Power Generation (kWh 10⁹)

Year	U.S. GW	U.S Prod. kWh 10 ⁹	World GW	World Prod. kWh 10 ⁹
2006	1,074	4,300	3,889	17,500
2030	1,213	5,000	7,033	36,364
2050 ¹	1,523		9,429	

● Note:

- The 2050 Installed Electric Power Plant Generating Capacities has growth rates of 1.3% and Annual Power Generation 2.4%.

U.S. SOLAR DEMAND

- TO PROVIDE 2,000 GW GENERATING CAPACITY FOR WORLD PV SOLAR WOULD ALLOW 400 GW FOR U.S. PV SOLAR BY 2050. FAR LESS THAN “SOLAR GRAND PLAN” OF 2,940 GW. THIS WOULD SUPPLY 8.9% OF U.S. ELECTRICITY BY 2050.

SOLAR HOUSING MATERIAL REQUIREMENTS

- BASIC COMMODITY MATERIALS FOR HOUSINGS TO ENCLOSE SOLAR CELLS AND WITHSTAND 120 MPH WINDS, 1" HAIL, AND RAIN. REQUIRES GLASS, PLASTIC, CONCRETE, COPPER, STEEL, AND ALUMINUM. THE REQUIREMENTS TO PROVIDE 2,000GW SOLAR GENERATION WOULD REQUIRE AN ANNUAL 32% INCREASE IN WORLD GLASS PRODUCTION, 9.4% OF WORLD ALUMINUM PRODUCTION, AND 1.4% OF WORLD COPPER PRODUCTION.

SOLAR CELL MATERIAL REQUIREMENTS

- SEMICONDUCTOR MATERIAL REQUIREMENTS WOULD REQUIRE AN ANNUAL INCREASE OF 2,600% PURIFIED SILICON AND 1,036% TELURIDE (THIN FILM) TO MEET WORLD DEMAND BY 2,050. OTHER SEMICONDUCTOR MATERIALS CAN BE USED.

WORLD COMMODITY DEMAND

- THE INCREASED COMMODITY REQUIREMENTS WOULD ALSO HAVE TO MEET:
 1. BOS REQUIREMENTS AND THERMAL SOLAR,
 2. PRODUCTION OF OTHER ENERGY SOURCES,
 3. BASIC COMMODITY REQUIREMENTS FOR THE INCREASED STANDARD OF LIVING IN UNDERDEVELOPED COUNTRIES.

PV SOLAR MANUFACTURING ENERGY REQUIREMENTS

- THE AMOUNT OF ENERGY THAT IS REQUIRED TO MANUFACTURE PV SOLAR SYSTEMS HAS BEEN ANALYZED AND CAN HAVE ENERGY PAYBACK TIME “EPBT” FROM 2 TO 7 YEARS. THE AVERAGE IS 4 YEARS. ELECTRICITY MUST INCLUDE 100% GROSS ENERGY CONSUMPTION.
- THE INCREASED COMMODITY DEMAND WILL INCREASE THE FUTURE COST OF PV SOLAR SYSTEMS AT LEAST AS FAST AS ENERGY COST ESCALATION RATE.

SOLAR THERMAL ENERGY

THERMAL SOLAR ENERGY IS 60%. POPULAR IN THE EARLY 1980'S AND FAILED BADLY: UNECONOMICALLY TYPICALLY FAILED IN 10 YEARS SHORT OF THE 25 YEAR DESIGN LIFE

- DOMESTIC HOT WATER – BEST UTILIZATION AND PAYBACK OF ALL SOLAR ENERGY.
- SPACE HEATING – WINTER UTILIZATION ONLY.

THERMAL SOLAR ENERGY

SOLAR DOMESTIC HOT WATER HEATER

	<u>New Haven, CT</u>	<u>Cleveland, OH</u>	<u>Los Alamos, NM</u>
• Installed cost	\$4,000	\$4,000	\$4,000
• Fed Tax credit	\$1,200	\$1,200	\$1,200
• Net Cost	\$2,800	\$2,800	\$2,800
• Financed Pay./yr	\$288/yr.	\$288/yr.	\$288/yr.
• Solar Rating	4.5 kWh/SM/day	4.5kWh/SM/day	6.0 kWh/SM/day
• Energy prod.	83 therm/yr	78 therm/yr	107 Therm/yr
• Fuel saved	11,900,000Btuh /yr	11,200,000 Btuh/yr	15,300,000 Btuh/yr
• Annual \$ saving	\$91 1 st year	\$83 1 st year	\$129 1 st year
• Ave. Annual \$ saving	\$124/yr	\$113/yr	\$176/yr
• Fifteen year saving	\$1,860	\$1,697	\$2,637

SOLAR ENERGY SUMMARY

- SOLAR ENERGY IS NOT COST EFFECTIVE TODAY AND BECAUSE IT IS MATERIAL AND ENERGY INTENSIVE, IT WILL PROBABLY NEVER BE COST EFFECTIVE.
- FEDERAL AND STATE TAX INCENTIVES HIDE THE TRUE COST OF SOLAR ENERGY AND ARE A POOR USE OF TAX PAYER AND RATE PAYER MONEY.
- FEDERAL AND STATE MANDATES THAT REQUIRE UTILITIES TO PROVIDE RENEWABLE ENERGY WILL LEAD TO SUBSTANTIALLY HIGHER ENERGY RATES.

WIND POWER

- THE DOE HAS RELEASED A REPORT THAT SUGGEST 20% WIND ENERGY BY 2030 IS A REALISTIC GOAL. IT IS ESTIMATED THAT 6% OF THE U.S. AREA CAN SUPPLY ALL OF OUR ELECTRICITY. WIND CORRIDORS.
- THE COST FOR WIND ENERGY IS \$2,000 to \$2,500/kW WHICH IS COMPARABLE TO REGULAR ELECTRIC POWER GENERATION.
- THE HIGHEST WIND AREAS CAN HAVE A 40% UTILIZATION RATE AND AVERAGE AREAS 30%.

WIND POWER PROBLEMS

- BACK UP POWER GENERATION IS REQUIRED.
- LOW UTILIZATION RATE FOR BOTH WIND POWER AND BACK UP POWER.
- TYPICALLY LOCATED IN RURAL AREAS AWAY FROM HIGH DEMAND AREAS.
- STILL DON'T HAVE GOOD LIFE CYCLE COST AND MAINTENANCE EXPERIENCE.
- REQUIRES TAX CREDITS AND GOVERNMENT MANDATES.
- ENVIRONMENTAL ASSESMENT REQUIRED TO SEE IF LARGE QUANTITIES AFFECT WEATHER.

HIGH VOLTAGE TRANSMISSION LINES

- TYPICALLY BOTH LARGE PV SOLAR SYSTEMS AND WIND POWER ARE LOCATED AWAY FROM AREAS OF LARGE ENERGY DEMAND. THEREFORE, BOTH CAN REQUIRE NEW POWER TRANSMISSION LINES TO CONNECT TO THE GRID.
- COORDINATION OF PV POWER AND WIND POWER SUPPLIES WITH TRANSITIONAL GENERATION OVER THE GRID IS COMPLICATED.
- BOTH PV SOLAR AND WIND POWER HAVE POOR UTILIZATION FACTORS AND THEREFORE THEY WILL REQUIRE HIGHER ELECTRICITY COSTS.

ETHANOL & BIOMASS

- ETHANOL IS NOT COST EFFECTIVE BECAUSE IT IS LAND AND ENERGY INTENSIVE. CORN AND SOYBEANS COMPETE WITH FOOD STOCKS.
- INCREASED DEMAND IS INCREASING WORLD COMMODITY PRICES.
- FURTHER RESEARCH AND DEVELOPMENT IS NECESSARY TO INVESTIGATE ALTERNATE BIOFUELS. THIS WILL TAKE TIME.

WORLD CRUDE OIL

- TRADITIONAL OIL – WE ARE REACHING A WORLD PEAK IN ENERGY. NEED NEW OIL TO REPLACE EXISTING.
 1. ON SHORE OIL
 2. OFF SHORE OIL
 3. ALASKAN OIL
 4. IMPORTED OIL
- NON TRADITIONAL OIL – EXPENSIVE AND HAS PROBLEMS.
 1. TAR SANDS
 2. COAL LIQUIFACTION
 3. ROCKY MOUNTAIN OIL SHALE

NATURAL GAS

- TRADITIONAL NATURAL GAS – U.S. PRODUCTION PEAKING.
 1. ON SHORE
 2. OFF SHORE
 3. IMPORTED
- NON-TRADITIONAL NATURAL GAS – BECOMING ECONOMIC AT HIGH PRICES.
 1. SHALE NATURAL GAS
 2. LIQUIDIFIED NATURAL GAS (LNG)
- INCREASED AVAILABILITY FROM CONSERVATION AND REDUCED DEMAND.

NUCLEAR POWER

- IN 2007, 104 EXISTING NUCLEAR POWER PLANTS OPERATING AT 91.8% UTILIZATION TO PROVIDE 19% U.S. ELECTRICITY.
- SEVERAL NEW PLANTS OF EXISTING DESIGNS ARE IN THE ENGINEERING, REGULATION, AND LICENSING. BEST IS FOR ONE TO BE OPERATION BY 2016.
- SEVERAL NEW CONCEPTS IN THE DESIGN AND DEVELOPMENT STAGE. WILL TAKE YEARS TO BUILD AND TEST PROTOTYPES.
- ESTIMATED COSTS HAVE INCREASED TO \$5,625/kW. WILL REQUIRE MUCH HIGHER ELECTRIC RATES THAN THE PAST.
- THE NUCLEAR INDUSTRY HAS BEEN SHUT DOWN FOR 30 YEARS. NEED NEW ENGINEERS AND NUCLEAR PRODUCTION INDUSTRY.
- THIS IS A MIDTERM AND LONG TERM SOLUTION.

HYDROGEN

- REQUIRES CONSIDERABLE RESEARCH AND DEVELOPMENT.
- LONG TERM SOLUTION.

ECONOMICS

- ENERGY AND ECONOMICS ARE DIRECTLY RELATED.
- U.S. INFLATION CAUSED BY ENERGY COST INCREASES CAN FIGHT TWO WAYS:
 1. ***MONETARY POLICIES*** OF FED INTEREST RATES AND MONEY SUPPLY. WORLD PROBLEM.
 2. ***FISCAL POLICIES*** OF LAWS AND REGULATIONS PASSED BY CONGRESS TO PROVIDE TAX INCENTIVES, ENERGY TAXES.
- FREE MARKET APPROACH HAS RESULTED IN LARGE SWINGS IN OIL PRICES FROM \$10 IN 2001 TO \$147 THIS YEAR. DESTABILIZING AND INEFFICIENT.

ECONOMICS

- CURRENT WORLD RECESSION HAS REDUCED ENERGY DEMAND AND WORLD ENERGY PRICES. MANY WORLD ENERGY PROJECTS ARE BEING POSTPONED. WILL SOON RESULT IN FUTURE SHORTAGES AND PRICE INCREASES.
- ENERGY TAXES AND TAX CREDITS CAN BOTH REDUCE ENERGY DEMAND. CHANGES HAVE TO BE SUFFICIENT TO ENACT ENERGY CONSERVATION RETROFITS.
- HIGHER ENERGY COSTS TO REDUCE DEMAND CAN EITHER BE FROM TAXES OR SHORTAGES.
 1. THE SHORTAGE METHOD WILL GIVE THE PROFIT TO FOREIGN COUNTRIES AND OIL COMPANIES.
 2. THE HIGHER ENERGY TAXES WILL REDUCE OUR DEFICIT.
- ENERGY TAXES PUT AN ADDED VALUE ON ENERGY TO REFLECT THE FUTURE VALUE OF FINITE RESOURCES.

GLOBAL WARMING

- ENERGY CONSERVATION WILL REDUCE CO₂ MORE THAN ANY OTHER ALTERNATE.
- WITH “BUILT” EFFICIENCY, SAVED NATURAL GAS CAN REPLACE 31% EFFICIENT COAL POWER PLANTS WITH 68% EFFICIENT COMBINED GAS CYCLE TURBINES.
- A CARBON TAX CAN BE EFFECTIVE. CARBON TAXES WOULD INCREASE THE FIRST COST OF SYSTEMS, SUCH AS SOLAR, WIND, AND NUCLEAR...WHICH WOULD CONSIDER THE AMOUNT OF ENERGY USED IN MANUFACTURING.

CONCLUSION

- WITH 3% OF THE WORLD'S POPULATION, WE USE 25% OF THE WORLD'S ENERGY.
- ENERGY CONSERVATION IS THE ONLY SOLUTION THAT CAN QUICKLY REDUCE THE FEDERAL TRADE DEFICIT.
- ENERGY CONSERVATION ALSO GAINS TIME IN ORDER TO PERFORM RESEARCH AND DEVELOPMENT FOR THE OTHER SOLUTIONS.
- A NATIONAL ENERGY PLAN CAN SET PRIORITIES TO PREVENT OVERLAPPING, EXCESSIVE ENERGY PRODUCTION, AND WASTE.
- A COMBINATION OF ENERGY TAX CREDITS AND ENERGY TAXES IS BEST. THEY MUST BE STRONG ENOUGH TO ENACT THE NECESSARY CHANGES.