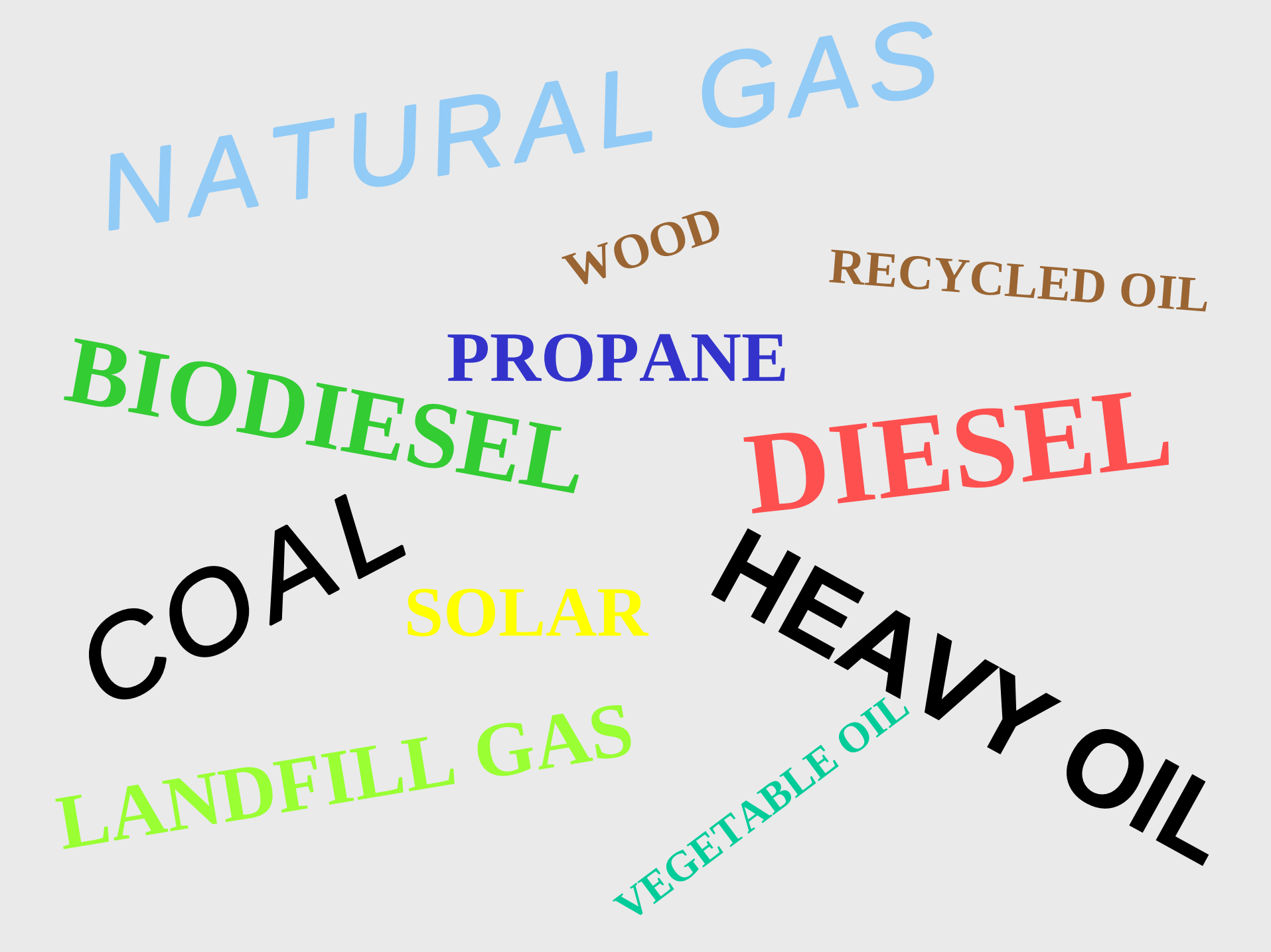
ALTERNATIVE ENERGY


NATURAL GAS
WOOD
RECYCLED OIL
PROPANE
BIODIESEL
DIESEL
COAL
SOLAR
HEAVY OIL
LANDFILL GAS
VEGETABLE OIL

TRADITIONAL MAINSTAY FUELS

- NO. 2 DIESEL
- NATURAL GAS
- PROPANE

WHAT'S WRONG WITH TRADITIONAL FUELS?

COST IS UNSTABLE AND CONTINUING GENERALLY TO INCREASE.

AVAILABILITY IS UNCERTAIN DUE TO HUGE VOLUME OF IMPORTS FROM UNFRIENDLY NATIONS.

THEY ARE NOT RENEWABLE.

THEY ARE ALL CARBON BASED.

ALTERNATIVE ENERGY SOURCES OFFER SOLUTIONS

- *RECYCLED PETROLEUM OILS*
- *BIODIESEL*
- *VEGETABLE OIL*
- *COAL*
- *WOOD*
- *SOLAR*

WHAT IS THE BEST ENERGY SOURCE?

BEFORE LOOKING MUCH AT ANY PARTICULAR FUEL LET'S CONSIDER AN ENERGY SOURCE SELECTION METHOD.

SELECTION FACTORS

LOOK SYSTEMATICALLY AT THE MAJOR SELECTION FACTORS THAT AFFECT ENERGY SOURCE CHOICES.

SOME CAN BE READILY QUANTIFIED, WHILE OTHER CANNOT BUT CONSIDER THEM ALL.

SELECTION FACTORS

- *ENVIRONMENT IMPACT*
- *AVAILABILITY*
- *COST PER HEAT UNIT*
- *MAINTENANCE COST IMPACT*
- *OPERATING COST IMPACT*
- *CAPITAL EQUIPMENT COST*

SELECTION FACTORS

ENVIRONMENT IMPACT

MOST FUELS CAN STILL BE USED ANYWHERE BUT THERE ARE EXCEPTIONS AND THINGS ARE CHANGING.

CONSIDER THE DIRECTION OF REGULATIONS AS WELL AS WHAT CURRENTLY EXISTS.

ENVIRONMENTAL ISSUES

- *GLOBAL WARMING*
  - *GREEN HOUSE GAS EMISSIONS*
- *SUSTAINABILITY*
  - *RENEWABLE ENERGY*
- *CARBON FOOTPRINT*
- *CAP AND TRADE*

EPA REGULATIONS – COMING CHANGES

EPA RECENTLY DETERMINED THAT GREENHOUSE GAS EMISSIONS ARE HARMFUL TO HUMAN HEALTH AND WILL BE REGULATED.

(THE ONLY WAY TO REDUCE CO2 EMISSIONS IS TO REDUCE FUEL BURNING.)

SELECTION FACTORS

AVAILABILITY

IF YOU CAN'T GET IT, NOTHING ELSE MATTERS.

FOR INSTANCE, COAL IS USUALLY THE LEAST COST FUEL BUT, IF YOU HAVE TO TRUCK IT A LONG DISTANCE, THAT MAY CHANGE.

OR, NATURAL GAS MAY BE THE LEAST COST AVAILABLE FUEL BUT, IF YOUR SERVICE IS INTERRUPTABLE IN HIGH DEMAND PERIODS, YOU NEED AN IMMEDIATELY AVAILABLE ALTERNATE.

SELECTION FACTORS

COST PER HEAT UNIT

ENERGY COST SHOULD BE EVALUATED ON A $/MMBTU BASIS RATHER THAN THE BASIS OF $/GAL OR $/CU.FT.

COST PER HEAT UNIT

Type of Energy	Heating Value (Net or LHV)		Billing Units	Cost Comparisons Based On Heating Values																
NO. 2 FUEL OIL	Btu/gal	132,000	Per Gallon	$0.80	$0.90	$1.00	$1.10	$1.20	$1.30	$1.40	$1.50	$1.60	$1.70	$1.80	$1.90	$2.00	$2.10	$2.20	$2.30	$2.40	$2.50
NO. 5 FUEL OIL	Btu/gal	143,250	Per Gallon	$0.87	$0.98	$1.09	$1.19	$1.30	$1.41	$1.52	$1.63	$1.74	$1.84	$1.95	$2.06	$2.17	$2.28	$2.39	$2.50	$2.60	$2.71
PROPANE (LPG)	Btu/gal	84,345	Per Gallon	$0.51	$0.58	$0.64	$0.70	$0.77	$0.83	$0.89	$0.96	$1.02	$1.09	$1.15	$1.21	$1.28	$1.34	$1.41	$1.47	$1.53	$1.60
NATURAL GAS	Btu/CCF (see note*)	90,500	Per CCF	$0.55	$0.62	$0.69	$0.75	$0.82	$0.89	$0.96	$1.03	$1.10	$1.17	$1.23	$1.30	$1.37	$1.44	$1.51	$1.58	$1.65	$1.71
	Btu/Therm	100,000	Per Therm	$0.61	$0.68	$0.76	$0.83	$0.91	$0.98	$1.06	$1.14	$1.21	$1.29	$1.36	$1.44	$1.52	$1.59	$1.67	$1.74	$1.82	$1.89
ELECTRICITY	Btu/Kwh	3,413	Per Kwh	$0.02	$0.02	$0.03	$0.03	$0.03	$0.03	$0.04	$0.04	$0.04	$0.04	$0.05	$0.05	$0.05	$0.05	$0.06	$0.06	$0.06	$0.06
COAL	Btu/pound	12,000	Per Ton	$145	$164	$182	$200	$218	$236	$255	$273	$291	$309	$327	$345	$364	$382	$400	$418	$436	$455

ON THE BASIS OF HEAT PROVIDED PER DOLLAR, THESE ARE ALL EQUAL VALUES:

1.	*WASTE OIL*	*$0.87/GAL **
2.	*NO. 2 OIL*	*$0.80/GAL*
3.	*NATURAL GAS*	*$5.50/1000 CU.FT.*
4.	*COAL*	*$145.00/TON*

SELECTION FACTORS

EACH FUEL HAS A COST ASSOCIATED WITH IT THAT IS RELATED TO IT'S IMPACT ON THE HMA PLANT TOO.

THERE IS AN UP FRONT "DOING IT RIGHT COST" OR A MUCH LARGER DOWNSTREAM "DOING IT WRONG COST".

SELECTION FACTORS

CONSIDER, AS AN EXAMPLE, RECYCLED OIL (RFO).

WHAT ARE SOME DOWNSTREAM "DOING IT WRONG COSTS"?

FIRST, REMEMBER TO SUBTRACT THE WATER.

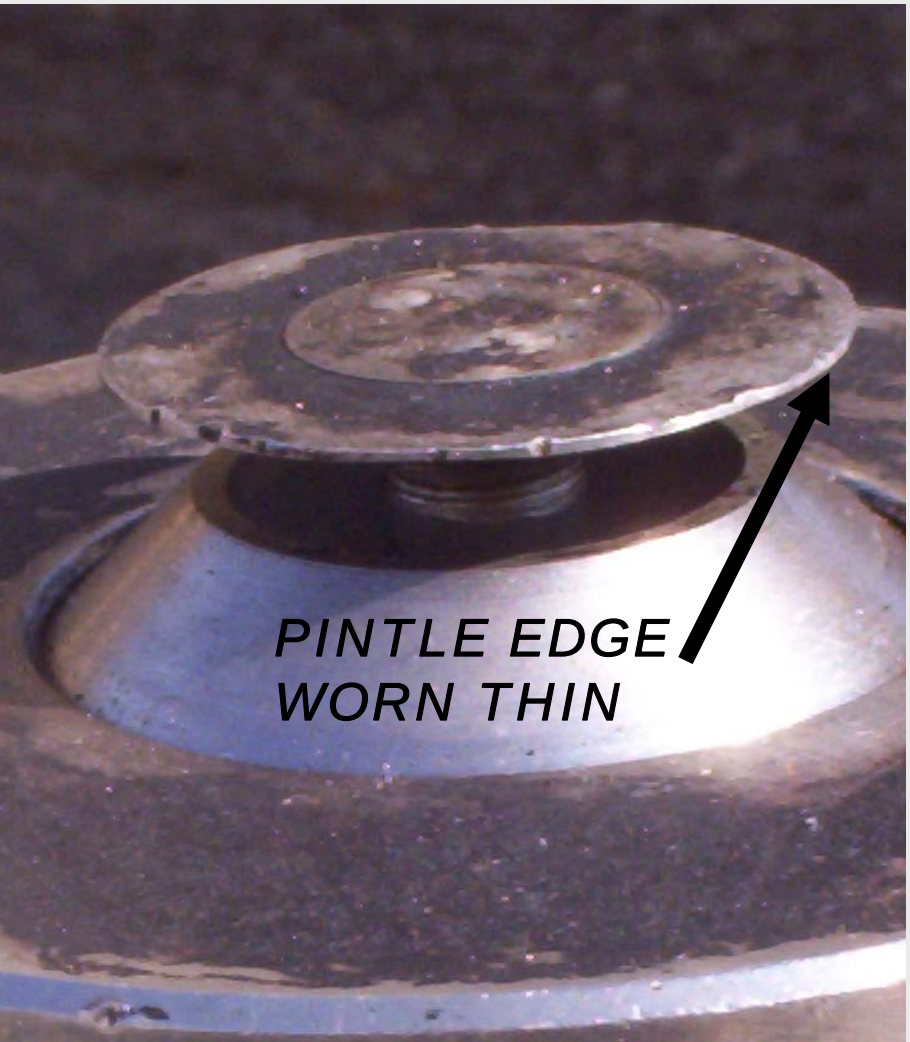
5% WATER IN THE FUEL AMOUNTS TO A DECREASE IN HEATING VALUE OF ABOUT ABOUT 7,500 BTU PER GALLON.

FUEL OIL HHV	*142,000 BTU/GAL*
WATER LOSS	*7,500 BTU/GAL*
USABLE HEAT	*134,500 BTU/GAL*

FUEL PUMPS WEAR OUT BUT THEY FAIL FASTER IF THE FUEL BEING PUMPED IS FOULED WITH TRASH.


MANY WASTE OIL BURNING
PROBLEMS ARE RELATED
TO POOR ATOMIZATION.

BURNER ATOMIZERS CAN WEAR OUT QUICKLY IF THE RFO CONTAINS A LOT OF ABRASIVE MATERIAL.



POOR ATOMIZATION, WHETHER IT'S CAUSED BY A WORN ATOMIZER OR COLD RFO, CAN DESTROY COMBUSTION ZONE FLIGHTS.

BEWARE OF CORROSIVE CONTAMINANTS

THIS DAMAGE WAS CAUSED BY SULFURIC ACID RESIDUAL FROM A RFO TREATMENT PROCESS.


POOR ATOMIZATION
CAUSE THIS
BAGHOUSE FIRE.
DANGER

YOU CAN BURN RECYCLED OIL
RELATIVELY CLEANLY AND EFFICIENTLY.

FILTER AT UNLOADING POINT.

VISCOSITY AT THE BURNER IS WHAT MATTERS.

- CONTROL VISCOSITY, NOT OIL TEMPERATURE.
- AVOID LONG UNINSULATED FUEL LINES.
- KEEP FUEL HOSES UP OFF OF THE GROUND AND OUT OF THE MUD.
- RECIRCULATE BEFORE LIGHTING.
- HEAT IN-LINE (OK TO HEAT TANK TOO BUT NOT INSTEAD OF IN-LINE.)

PREHEAT AND THEN TRANSPORT IN INSULATING LINES.

THIS WASTE OIL SYSTEM WORKS WELL EVEN WITH LONG PIPING RUNS BECAUSE THE PIPING IS WELL INSULATED.

BIODIESEL

BIODIESEL

THE TERM "BIODIESEL" APPLIES TO A GROUP OF FUELS THAT MEET A CERTAIN ASTM SPECIFICATION.

BIODIESELS ARE BLENDS OF PETROLEUM DIESEL FUEL AND A VEGETABLE SOURCE (BIO) OIL. THERE ARE ASTM SPECIFICATION FOR EACH PARTICULAR BLEND.

BIODIESEL

BIODIESEL IS PRIMARILY A LOWER EMISSIONS ALTERNATIVE TO PETROLEUM FUEL OILS.

IT PRODUCES SUBSTANTIALLY LOWER SULFUR AND CARBON MONOXIDE EMISSIONS.

BIODIESEL

IT COSTS ABOUT THE SAME AS NO. 2, DUE TO TAX INCENTIVES AT THE BLENDER LEVEL.

Table 9. Biodiesel (B20) Average Prices by Region from Clean Cities Sources

	Biodiesel (B20) Information Reported by Clean Cities ($ per gal)		*Diesel Information Reported by Clean Cities ($ per gal)*	
	Average Price / Standard Deviation of Price	*Approximate Number of Stations*	*Average Price / Standard Deviation of Price*	*Approximate Number of Stations*
New England	$2.96 / 0.00	2	$3.04 / 0.08	17
Central Atlantic	--	--	$3.01 / 0.10	31
Lower Atlantic	$2.82 / 0.06	16	$2.93 / 0.06	39
Midwest	$2.86 / 0.10	3	$2.88 / 0.10	146
Gulf Coast	$2.94 / 0.20	2	$2.89 / 0.04	33
Rocky Mountain	$2.91 / -.--	1	$3.03 / 0.16	23
West Coast	$3.26 / 0.34	5	$3.25 / 0.13	58
NATIONAL AVERAGE	$2.92 / 0.22	29	$2.98 / 0.17	347

B20, A BLEND OF 20 % BIODIESEL AND 80% NO. 2 DIESEL CAN BE BURNED IN PLANT APPLICATIONS AND EVEN IN MOST DIESEL ENGINES.

Table 11. Biodiesel (B99-B100) Average Prices by Region from Clean Cities Sources

	Biodiesel (B99-B100) Information Reported by Clean Cities ($ per gal)		*Diesel Information Reported by Clean Cities ($ per gal)*	
	Average Price / Standard Deviation of Price	*Number of Data Points*	*Average Price / Standard Deviation of Price*	*Number of Data Points*
New England	$3.89 / 0.51	4	$3.04 / 0.08	17
Central Atlantic	$3.00 / -.--	1	$3.01 / 0.10	31
Lower Atlantic	$3.98 / -.--	1	$2.93 / 0.06	39
Midwest	--	--	$2.88 / 0.10	146
Gulf Coast	$2.75 / -.--	1	$2.89 / 0.04	33
Rocky Mountain	--	--	$3.03 / 0.16	23
West Coast	$4.02 / 1.30	4	$3.25 / 0.13	58
NATIONAL AVERAGE	$3.76 / 0.89	11	$2.98 / 0.17	347

B99-B100 IS VERY VISCOUS (THICK) AND MUST BE PREHEATED LIKE RECYCLED MOTOR OIL OR HEAVY VIRGIN OIL TO BE MADE THIN ENOUGH TO ATOMIZE SUFFICIENTLY FOR BURNER FIRING.

Sulfur Content

ASTM D4294

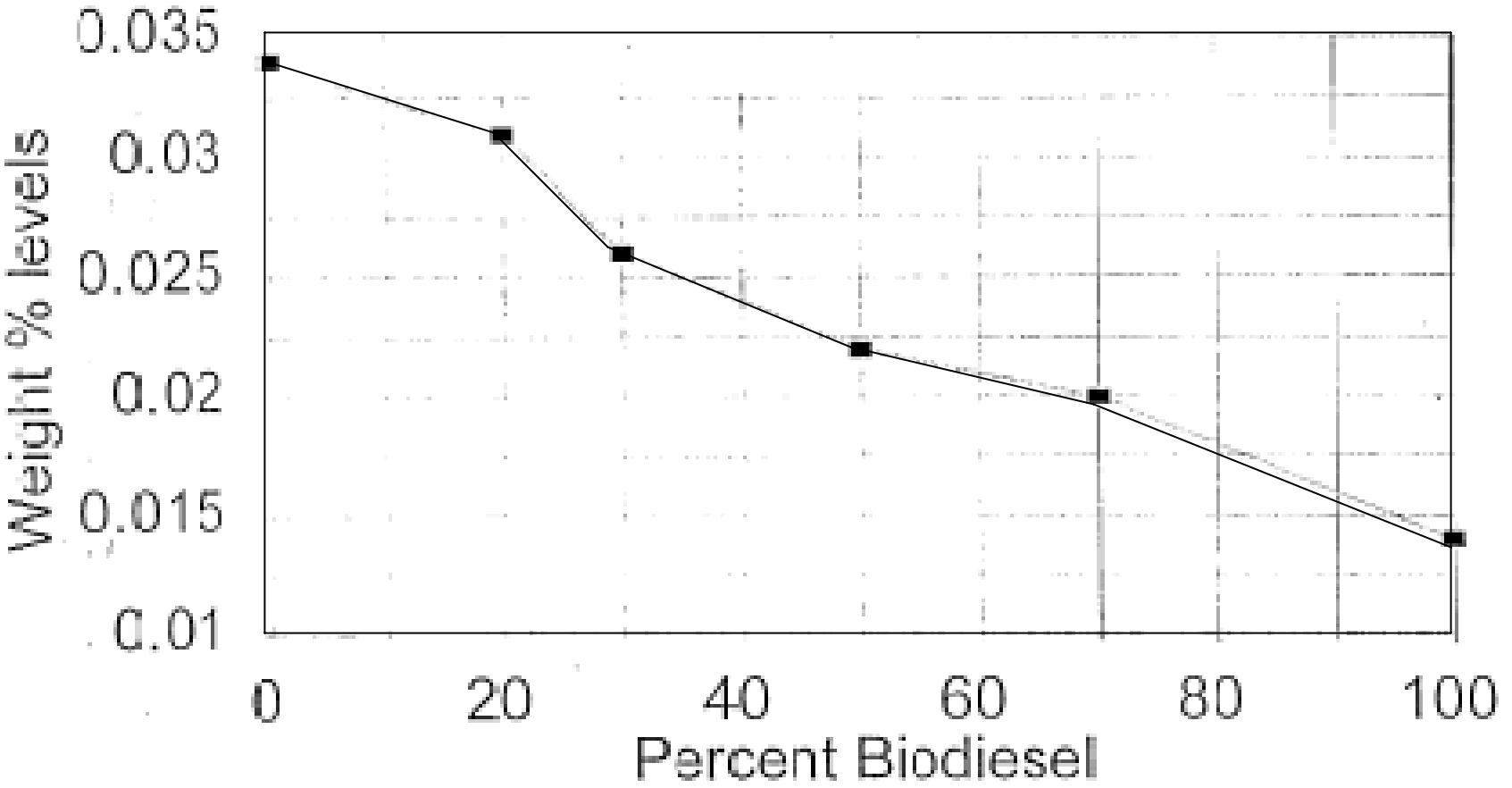


Fig. 18

Reference diesel fuel was used to prepare these blends.

Heat of Combustion

ASTM D3338

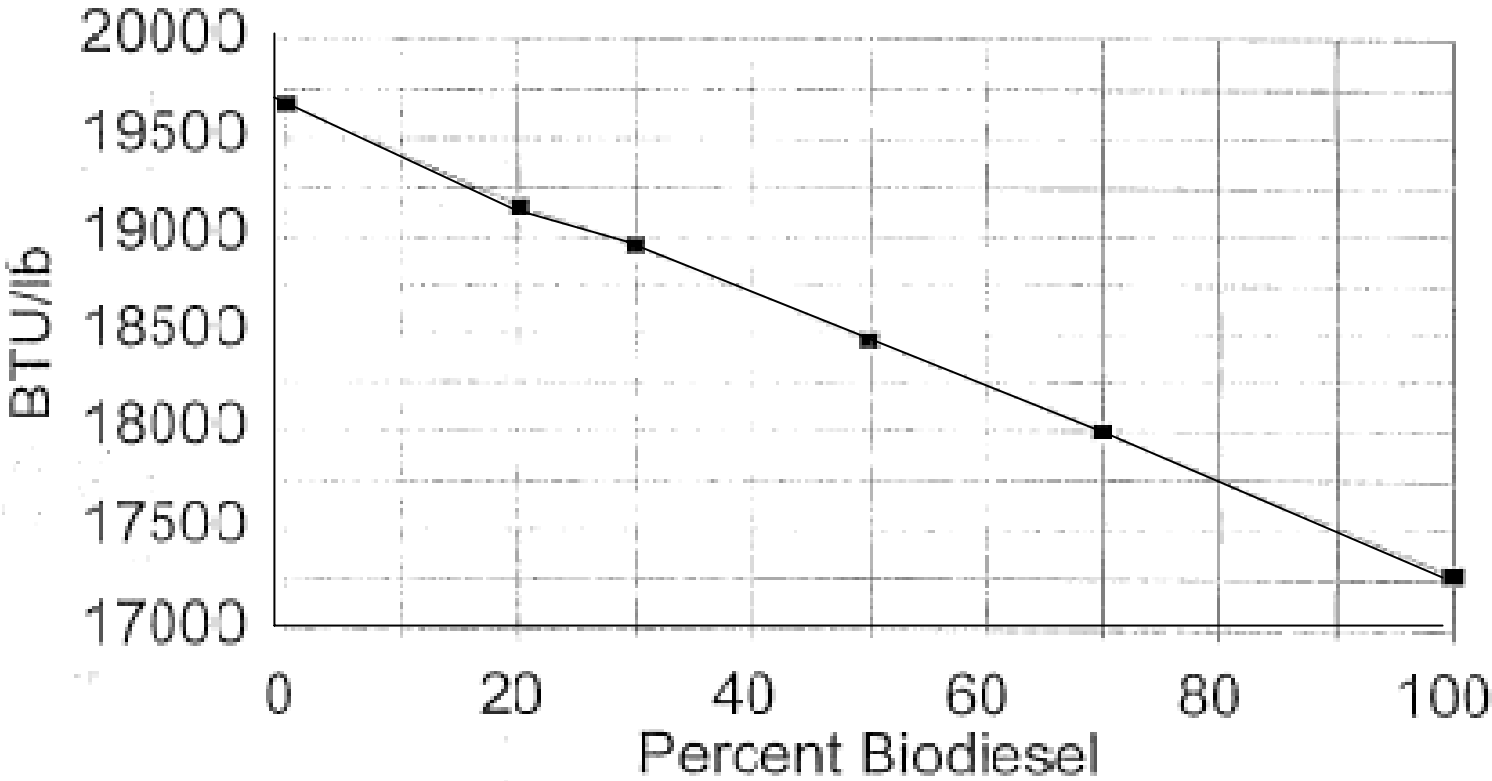


Fig. 31

Low sulfer diesel was purchased locally from MFA Oil Company to prepare these blends.

Viscosity

ASTM D445

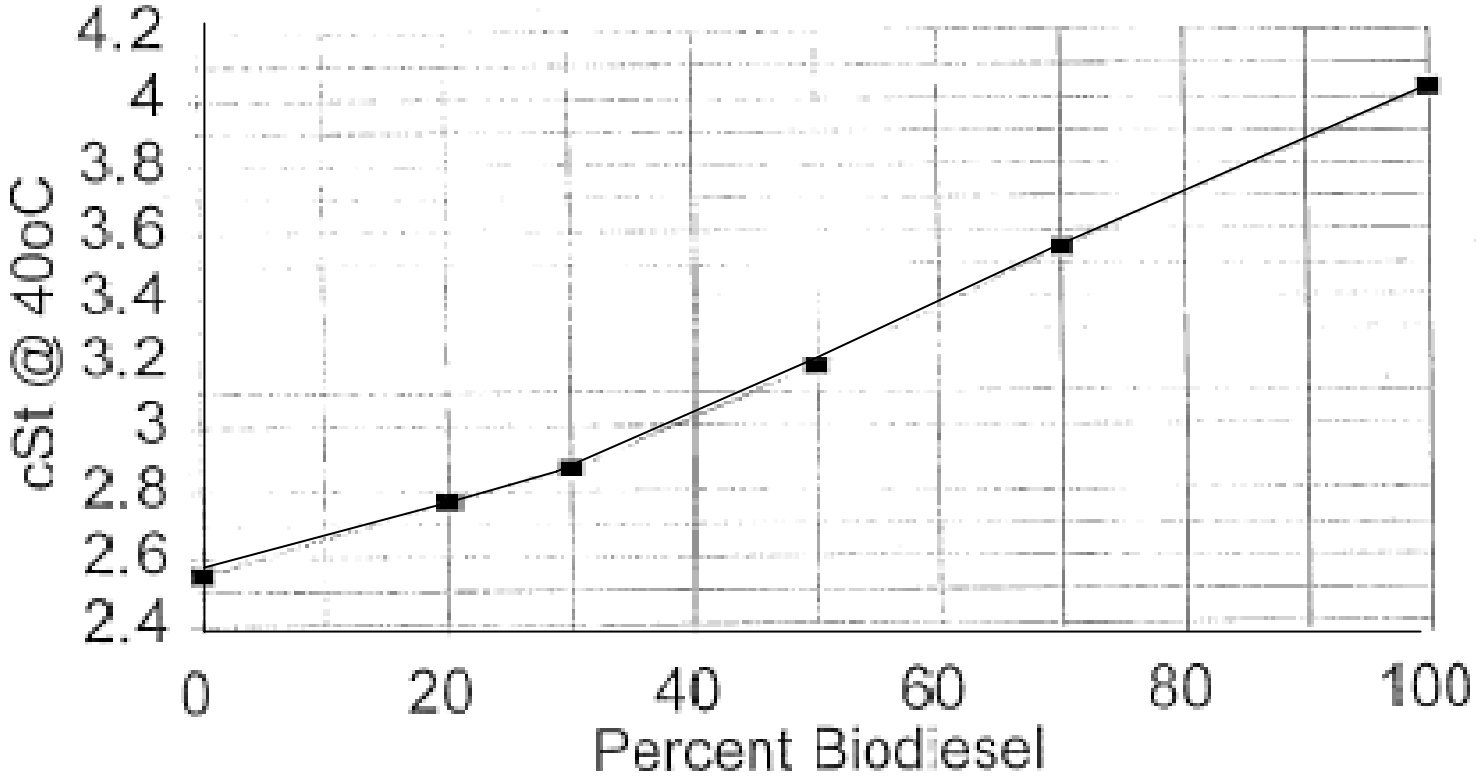


Fig. 30

Low sulfur diesel was purchased locally from MFA Oil Company to prepare these blends.

VEGETABLE OIL

VEGETABLE OIL

VEGETABLE OIL IN THIS INDUSTRY MEANS PRIMARILY WASTE VEGETABLE OIL (WVO). THIS IS MAINLY USED COOKING OIL.

WVO IS GENERALLY LOW COST BUT CAN BE TROUBLESOME.

WASTE VEGETABLE OIL

- PRICE IS USUALLY LOW.
- WVO HAS GOOD HEATING VALUE SIMILAR TO RECYCLED MOTOR OIL.
- WATER CONTENT, SOLIDS, AND CORROSIVES CAN BE PROBLEMS
  - CORROSVES – WVO USUALLY CONTAINS CLEANING AGENTS, WHICH TEND TO INCLUDE NaOH (CAUSTIC) AND NaCl (SALT)


COAL

COAL

COAL HAS BEEN USED IN THE HMA INDUSTRY FOR MANY YEARS.

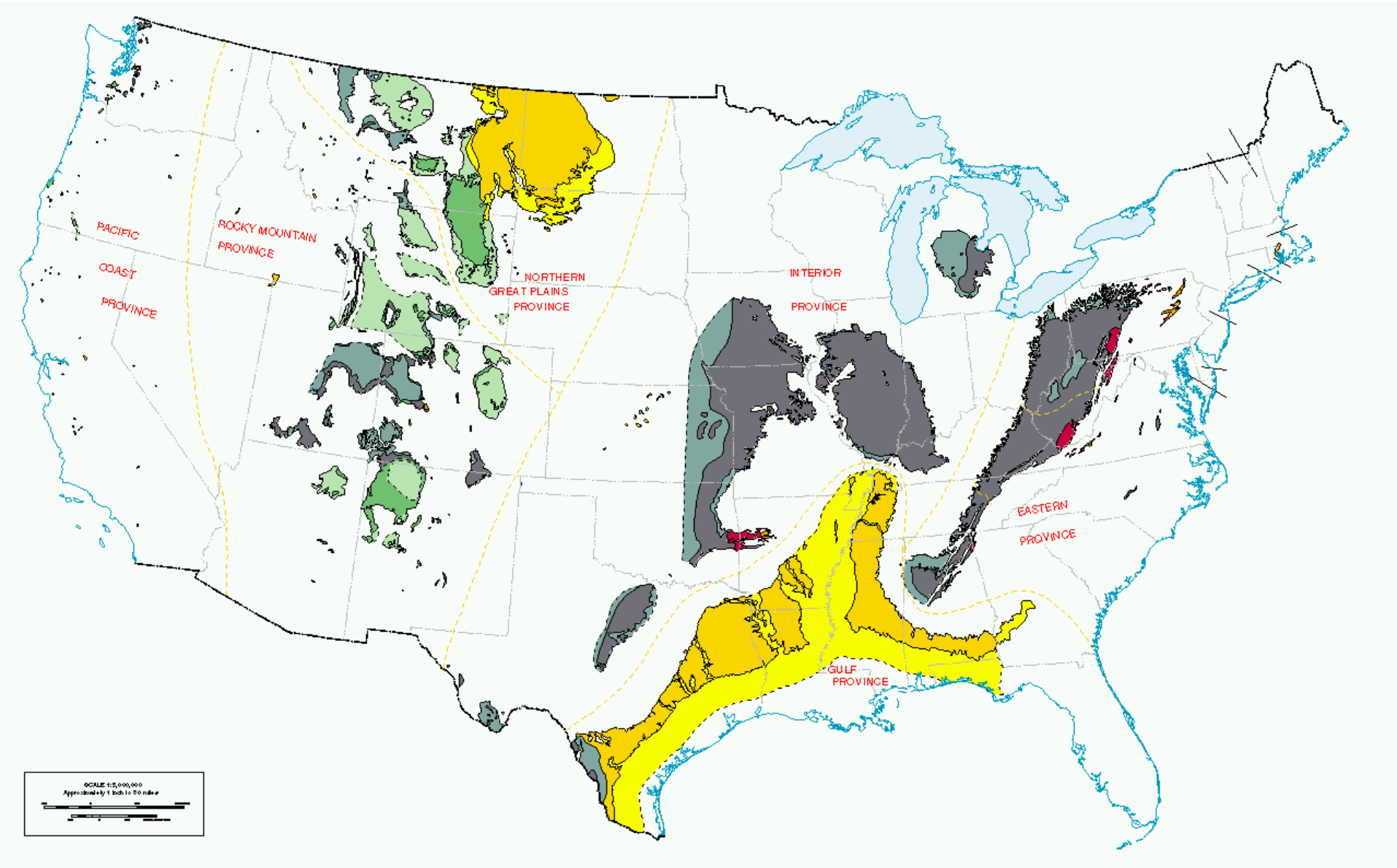
LOWEST COST OF ALL FUELS.

QUESTIONS ABOUT BURNING COAL

1. *HOW MUCH MONEY WILL COAL SAVE?*
2. *HOW AVAILABLE IS COAL?*
3. *WHAT KIND OF COAL?*
4. *ABILITY TO GET AIR POLLUTION PERMIT DUE TO HIGHER EMISSIONS LEVELS?*
5. *HOW IS THE COAL PREPARED TO BURN?*
6. *OPERATING AND MAINTENANCE COST AS COMPARED TO GAS OR AND WASTE OIL?*
7. *COMPLEXITY AND OPERATIONAL DIFFICULTY?*
8. *FLEXIBILITY TO BURN OTHER FUELS AND COMBINATIONS OF FUELS?*
9. *ELECTRIC POWER CONSUMPTION?*

ON THE BASIS OF HEAT PER DOLLAR, 12,500 BTU/LB COAL AT $100/TON, IS AN EQUIVALENT VALUE TO OIL AT $0.55/GAL. OR NATURAL GAS AT $0.40/THERM.

THE U.S. HAS MORE ENERGY AVAILABLE AS COAL THAN IS AVAILABLE FROM THE ENTIRE WORLD'S PROVEN OIL RESERVES.



TYPES OF COAL

- LIGNITE
- SUBBITUMINOUS
- BITUMINOUS
- ANTHRACITE

ONLY ANTHACITE COALS ARE UNSUITABLE AS FUELS FOR HMA PRODUCTION.

IMPORTANT COAL PROPERTIES

- HEATING VALUE
- GRINDABILITY
- % VOLATILE MATTER
- SULFUR CONTENT

COAL SPECIFICATION

BECAUSE THESE IMPORTANT PROPERTIES OF COAL VARY CONSIDERABLY, IT IS NECESSARY TO HAVE A COAL SPECIFICATION WHEN YOU PURCHASE YOUR FUEL.

RECOMMENDED COAL SPECIFICATIONS

- *WASHED GRADATION 1” X ¼”*
- *HARDGROVE INDEX > 50*
- *VOLATILE MATTER > 34%*
- *MOISTURE < 5% surface (inherent n/a)*
- *SULFUR <1% (recommended)*
- *HEATING VALUE > 10,500 BTU’s/POUND HHV*

HOT MIX ASPHALT PLANTS ARE GREAT CANDIDATES FOR COAL, BECAUSE .....

THEY HAVE "BUILT-IN" SOLUTIONS TO THE TWO MOST SIGNIFICANT DETERENTS TO BURNING COAL.

SULFUR

THE HOT MIX MAKING PROCESS IS A NATURAL SULFUR "SCRUBBER" WITH REMOVAL EFFICIENCY UP TO 90%.

ASH

YOU WILL NEVER SEE AN ASH POND AT A HOT MIX PLANT. ESSENTIALLY 100% OF THE COAL ASH IS CAPTURED AND INCORPORATED INTO THE HOT MIX.

STACK EMISSIONS ARE LOW

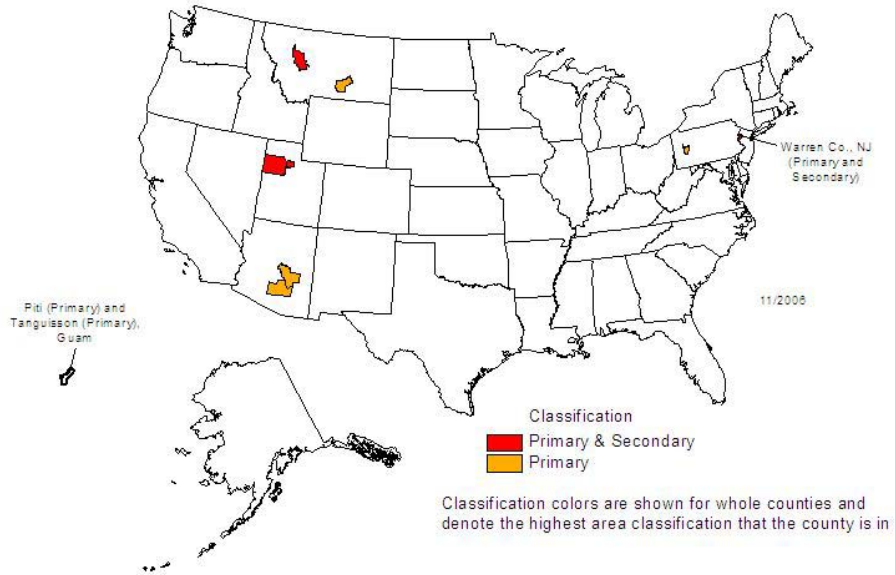
(ACTUAL EMISSION AT A COLORADO PLANT)

• PARTICULATE	ZERO OPACITY
• CARBON MONOXIDE	260 PPMV
• NOX	120 PPMV
• SO2	53 PPMV *

NOTE: GASEOUS EMISSONS ARE BASED ON 7% O2 REFERENCE.

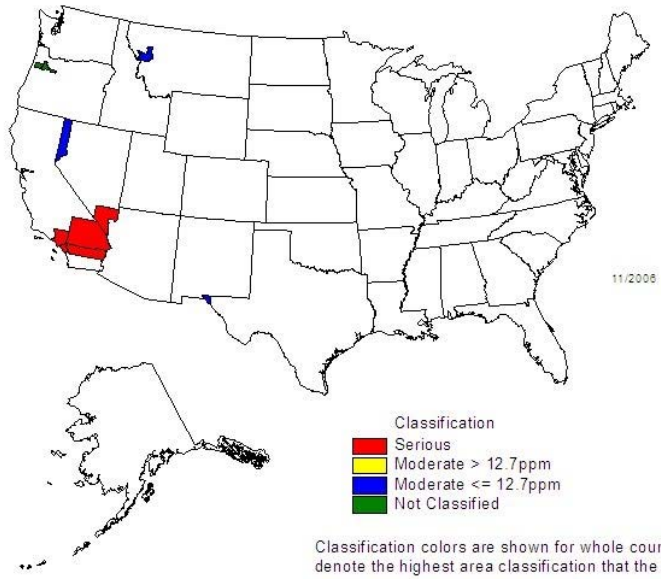
** NOT CORRECTED*

Counties Designated Nonattainment for SO2



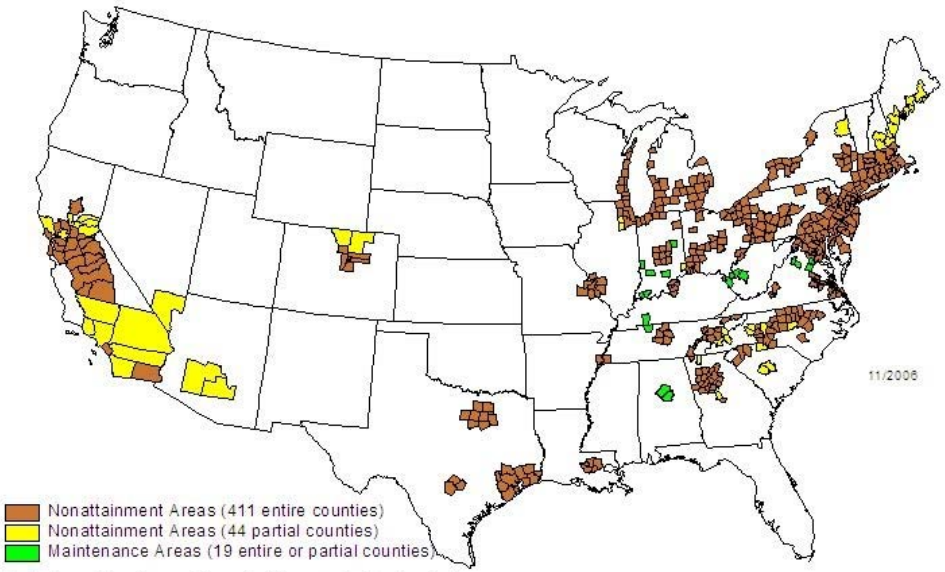
Classification colors are shown for whole counties and denote the highest area classification that the county is in

Counties Designated Nonattainment for Carbon Monoxide



Classification colors are shown for whole counties and denote the highest area classification that the county is in

Nonattainment and Maintenance Areas in the U. S.
8-hour Ozone Standard



Partial counties, those with part of the county designated nonattainment and part attainment, are shown as full counties on the map.

BECAUSE EMISSIONS ARE RELATIVELY LOW, HOT MIX PLANTS CAN BE PERMITTED TO BURN COAL ALMOST ANYWHERE IN THE UNITED STATES.

COAL BURNING IS A TWO PART PROCESS.

1. COAL MUST FIRST BE METERED, PULVERIZED, AND DRIED.

2. SECONDLY, PULVERIZED COAL DUST IS BLOWN TO THE BURNER AND BURNED.

COAL IS REDUCED TO ABOUT 80 TO 85% PASSING THE 200 SIEVE.

KEEP YOUR COAL DRY

WET COAL MUST BE DRIED. DRYING COAL ADDS EXPENSE AND OPERATIONAL PROBLEMS. THESE ISSUES ARE AVOIDED BY STORING YOUR COAL UNDER ROOF AND BY USING A COVERED FEED BIN.

COAL SYSTEM
RETURN ON INVESTMENT

RETURN ON INVESTMENT FOR A COAL BURNING SYSTEM IS USUALLY UNDER 3 YEARS.

WOOD

WOOD AS AN INDUSTRIAL FUEL

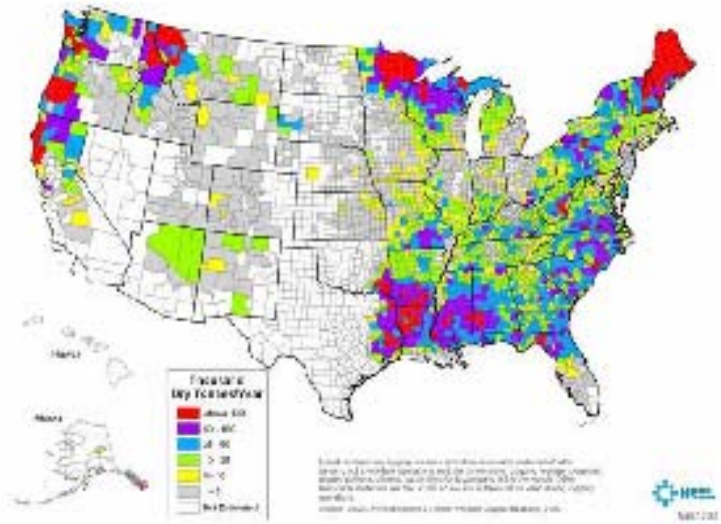
- **Encourages best practices in forest management**
- **Reduces reliance on fossil fuel and contributes to our energy security**
- **Is CO_2-neutral; CO_2 captured during growth is similar to CO_2 released with energy**

ADAGE

Our Nation Has More Than Enough Resources To Sustainably Meet The Demand For Wood Biomass

Biomass Feedstock:

- One third of U.S. Land is Forested
  - 750 million acres in total
  - 20 billion bone dry tons
- Departments of Energy and Agriculture prepared the "Billion Ton Study" in 2005 to document biomass resources



- Identified New Sustainable Resource of 200 million bdt/year (1% of forest land)
  - majority from sources not utilized - logging residues and fuel treatment

Federal Incentives For The Biopower Market

Federal incentives in the form of tax Credits or grants are available for Wood burning applications.

ADAGE

WOOD

HEATING VALUE ABOUT - 8,000 BTU/LB

MOISTURE - 10% (PREDRIED)

GHG EMISSION – 0

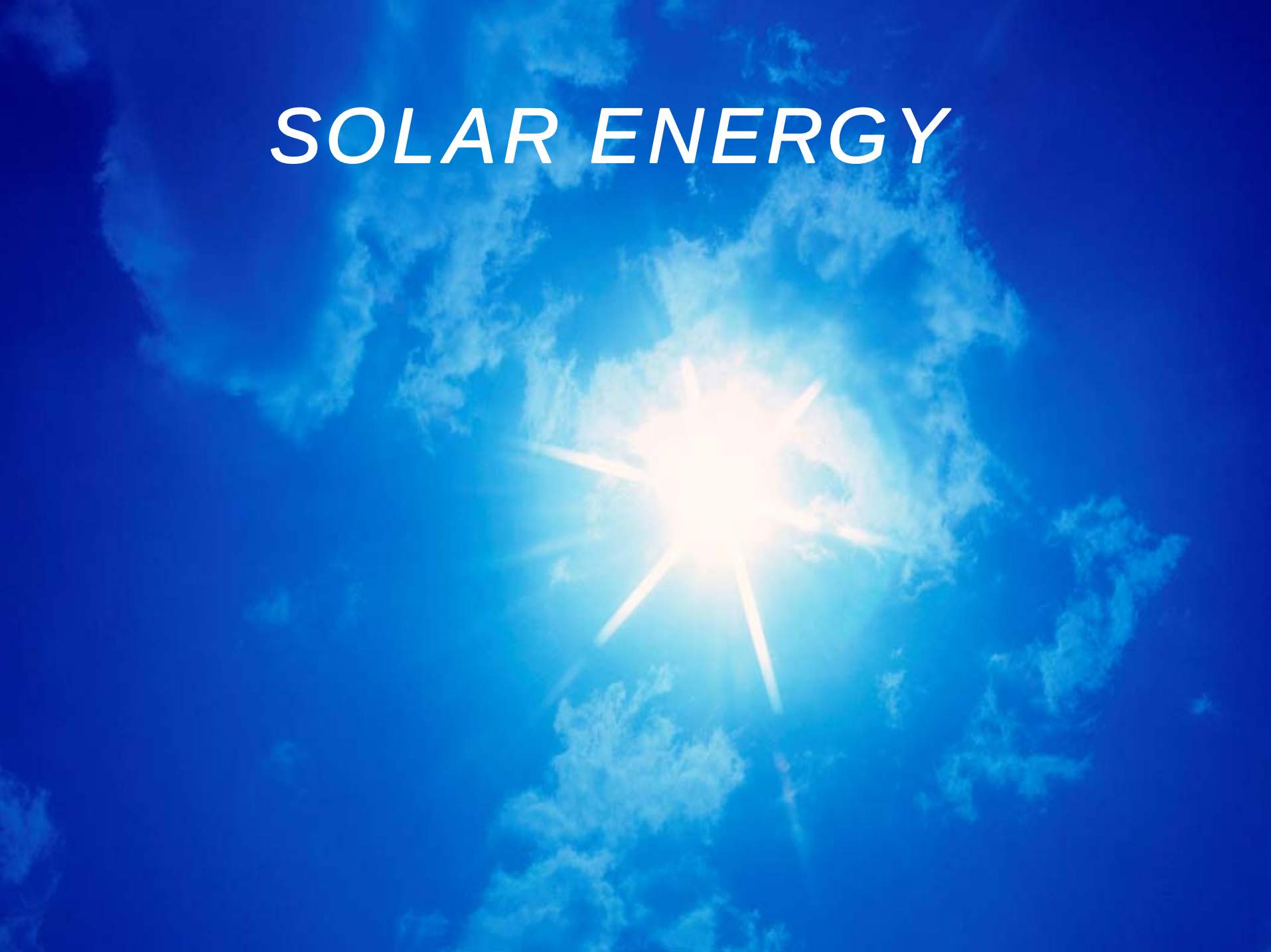
SULFUR EMISSIONS - 0

60 micron Maple flour

South Georgia Wood Pellet Plant

ALTERNATIVE ENERGY

SOLAR ENERGY



WHY SOLAR ENERGY IN THE ASPHALT BUSINESS.....

...0R WHAT'S WRONG WITH TRADITIONAL FOSSIL FUELS?

COST IS UNSTABLE AND CONTINUING GENERALLY TO INCREASE.

AVAILABILITY IS UNCERTAIN DUE TO HUGE VOLUME OF IMPORTS FROM UNFRIENDLY NATIONS.

THEY ARE NOT RENEWABLE.

THEY ARE ALL CARBON BASED.

WHY SOLAR ENERGY IN THE ASPHALT BUSINESS?

- ENVIRONMENTAL ISSUES
- PUBLIC RELATIONS
- ECONOMICS

ENVIRONMENTAL BENEFITS OF SOLAR ENERGY

- *ZERO CARBON*
- *ZERO GREENHOUSE GASES*
- *ZERO TOTAL EMISSIONS*
- *100% RENEWABLE*

PUBLIC RELATIONS

IT'S A GREEN THING.

ECONOMICS 101 – FREE IS GOOD!

GREEN IS GREEN $$$$$$.

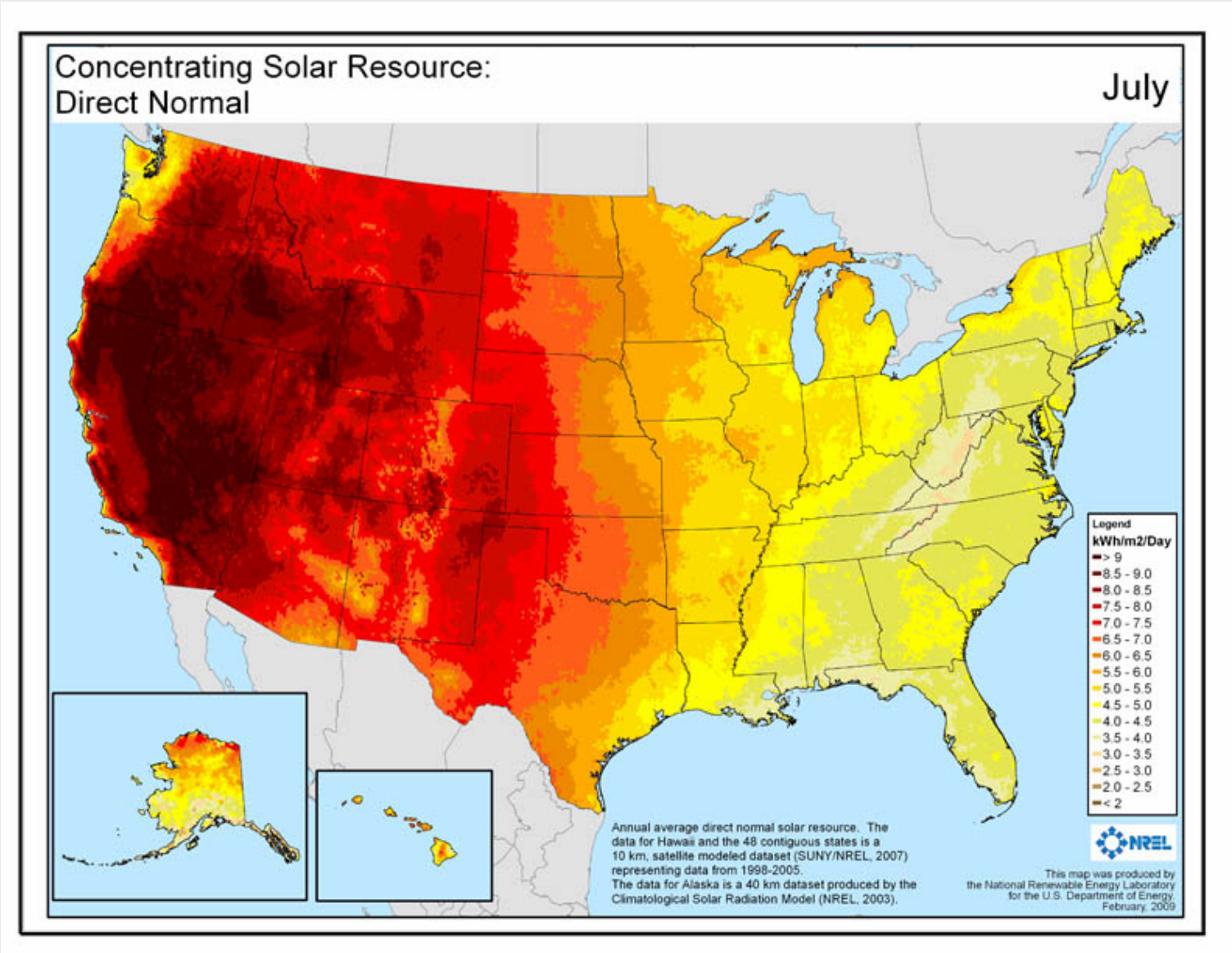
ECONOMIC ADVANTAGES OF SOLAR ENERGY

- *ZERO ENERGY COST*
- *AVAILABILITY OF INCENTIVES*
- *FAVORABLE LIFECYCLE COST EVALUATION*

SOLAR ENERGY AVAILABILITY

BEST AVAILABILITY IN THE U.S. IS IN THE SOUTHWEST BUT VIABLE SOLAR ENERGY IS AVAILABLE THROUGHOUT MUCH OF THE COUNTRY.

SOLAR ENERGY AVAILABILITY IN AVERAGE KWHR/SQMETER/DAY



CONCENTRATING SOLAR THERMAL

WHAT IS CONCENTRATING SOLAR THERMAL?

COLLECTION OF SUNLIGHT FROM A LARGE AREA BEING FOCUSED DOWN TO A SMALL AREA TO PRODUCE HIGH TEMPERATURES.

WHAT IS CONCENTRATING SOLAR THERMAL?

TYPICAL SYSTEMS CONSIST OF COLLECTORS, FLUID CIRCULATING SYSTEMS, HEAT LOAD, AND HEAT STORAGE FACILTY.

PARABOLIC TROUGH MIRRORS

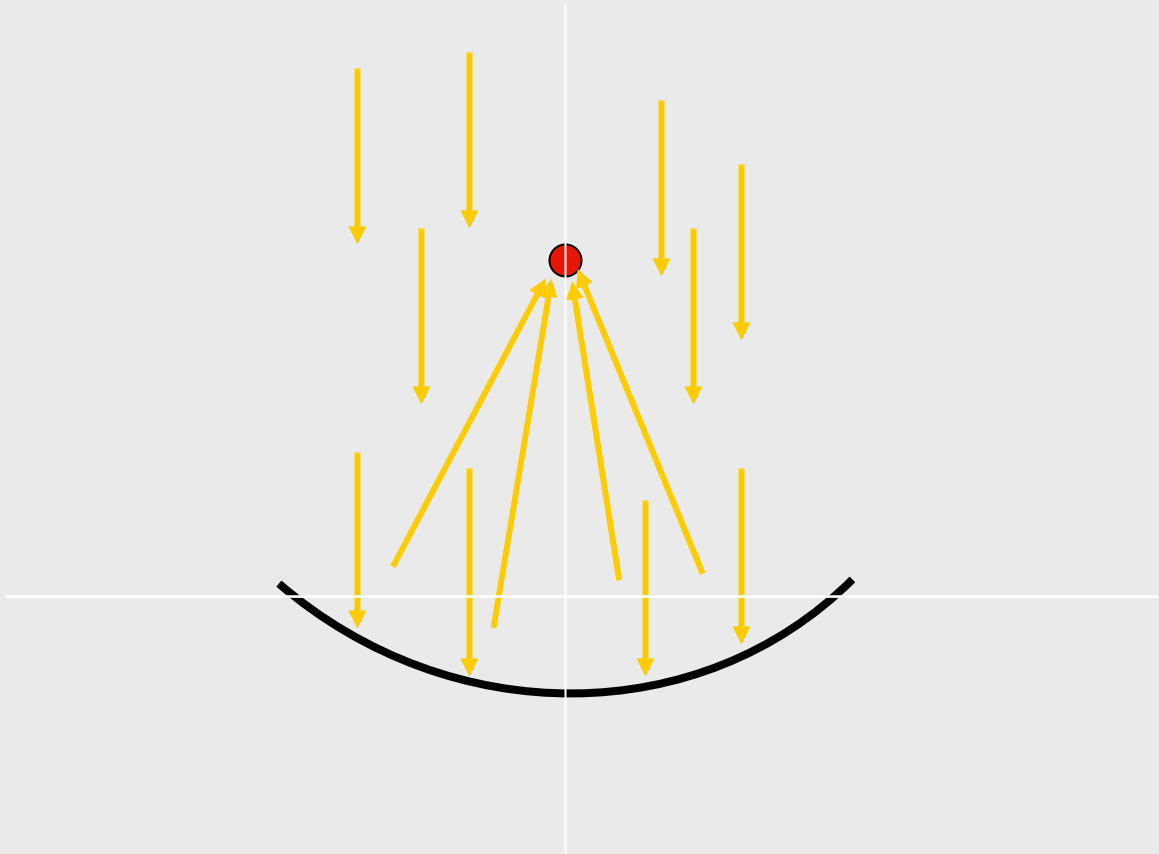
MIRRORS ARE ORIENTED SO THAT THEY CAN ROTATE ABOUT A TRUE NORTH-SOUTH AXIS TO TRACK THE SUN FROM EAST TO WEST.

UNLIKE OTHER SOLAR ENERGY TECHNOLGIES, CONCENTRATING SOLAR THERMAL SYSTEMS CAN PRODUCE TEMPERATURES APPROACHING 7,000 F.

MIRROR ARRAY FOR SOLAR POWER PLANT IN THE MOJAVE DESERT

CONCENTRATING SOLAR THERMAL (CST) SYSTEMS USE PARABOLIC MIRRORS SIMILAR TO THOSE USED IN CONCENTRATING SOLAR POWER (CSP) SYSTEMS FOR INDUSTRIAL HEAT APPLICATIONS.

PARABOLIC TROUGH MIRRORS CONCENTRATE INCOMING SUNLIGHT ON A RECEIVER PIPE LOCATED ALONG THE FOCUS OF THE PARABOLA.



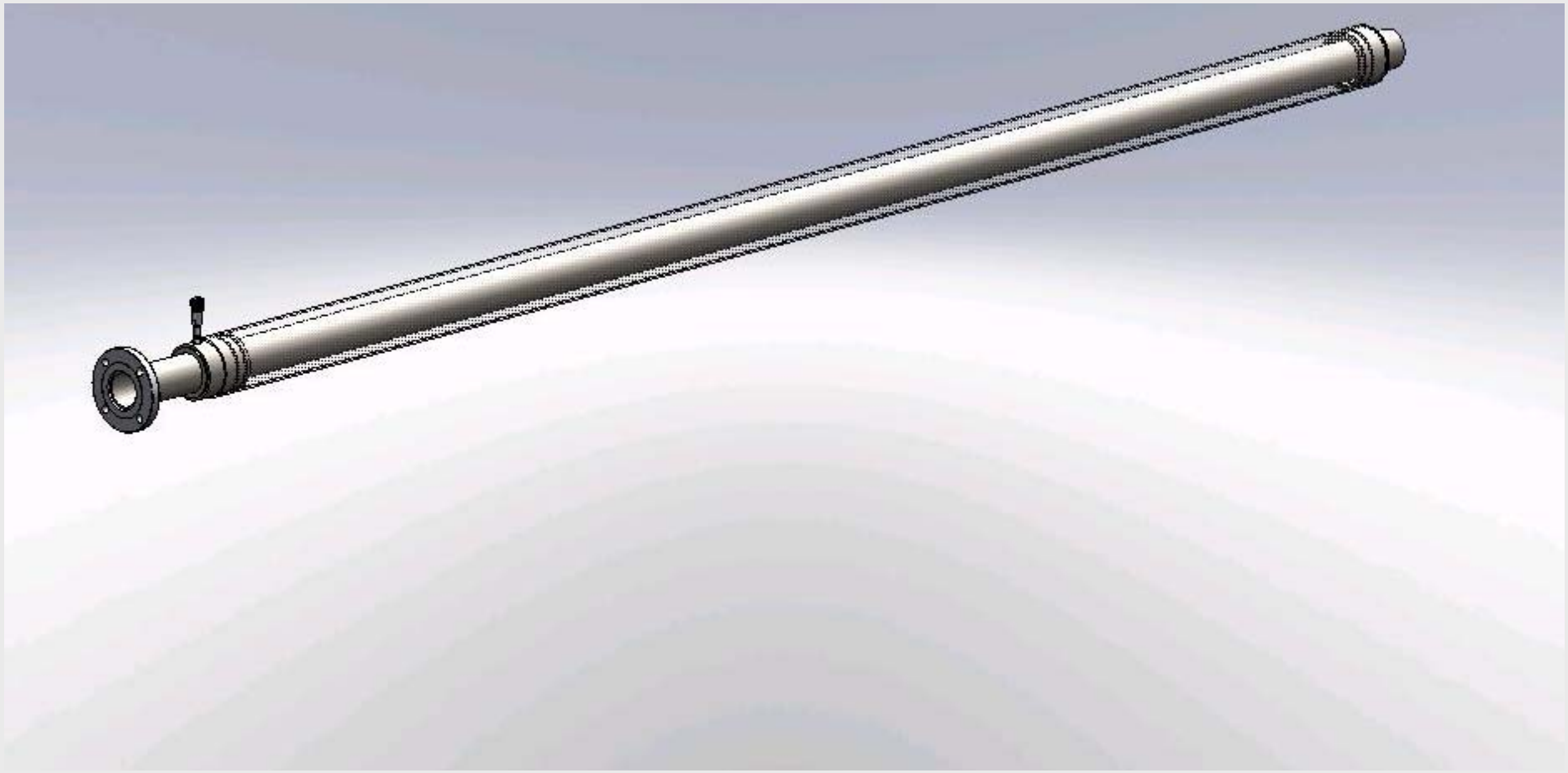
FOCUSED ENERGY IS CAPTURED IN A HEAT TRANSFER FLUID FLOWING THROUGH THE RECEIVER PIPE.

RECEIVERS

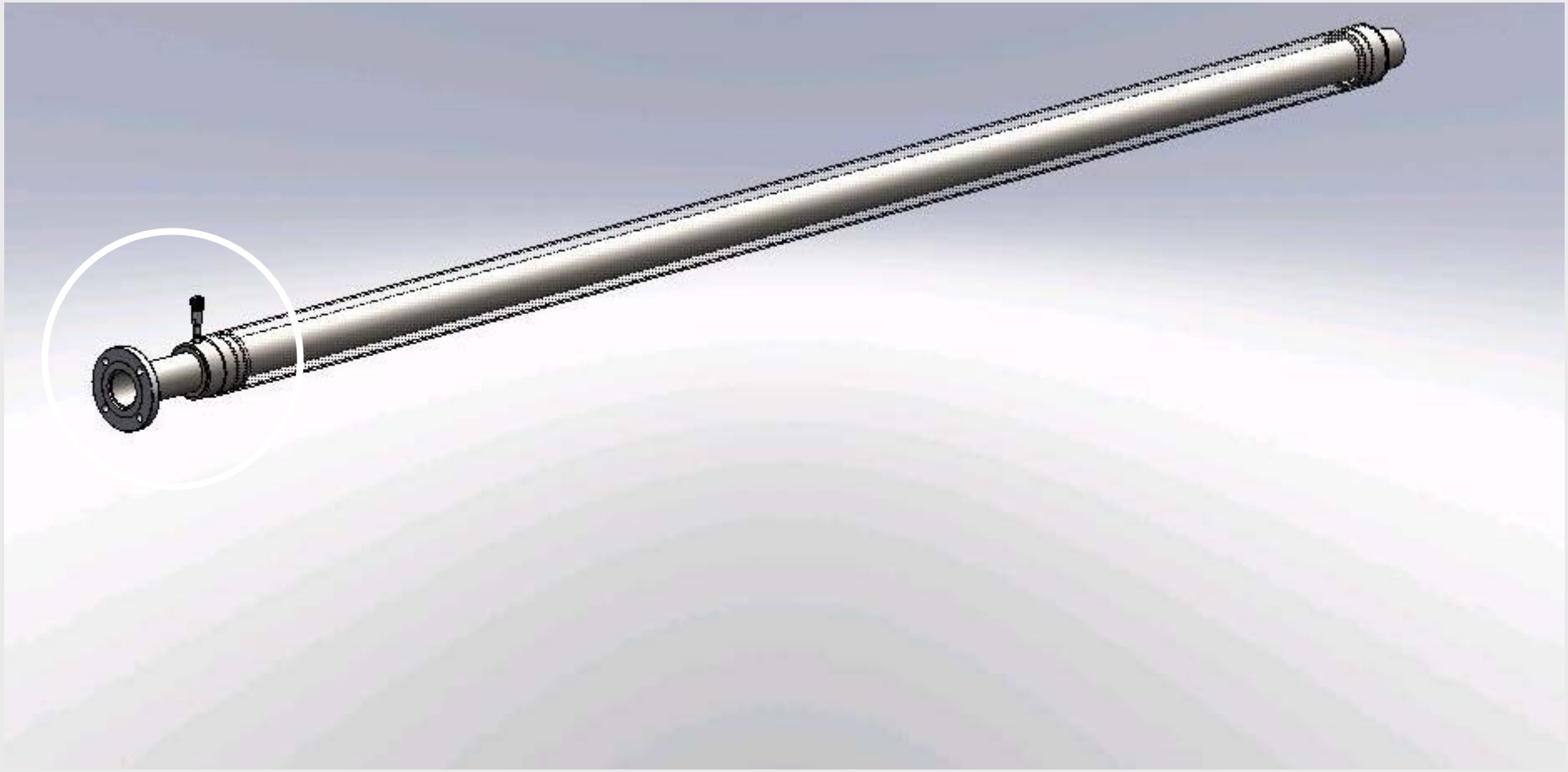
STEEL PIPE WITH ABSORPTIVE COATING.

COATED PIPE ENCASED IN CLEAR EVACUATED TUBE.

THE COATINGS ABSORB SOLAR ENERGY AND TRAP HEAT. VACUUM TUBE ALLOWS SUNLIGHT TO PASS THROUGH TO THE RECEIVER AND RESTRICTS HEAT LOSSES.



THE RECEIVER VACUUM SEAL IS A CRITICAL ELEMENT IN MAKING THE RECEIVER WORK.



HOT OIL

HOT OIL IS HEATED AS IT CIRCULATES THROUGH THE MIRROR RECEIVER. OIL OPERATING TEMPERATURES CAN REACH 700F WITH SILICONE OILS. MUCH LESS EXPENSIVE MINERAL HEAT TRANSFER OILS CAN OPERATE UP TO 600F. TYPICAL OPERATING TEMPERATURES FOR ASPHALT FACILITIES WILL BE ABOUT 400F.

ASPHALT APPLICATIONS OF SOLAR ENERGY HAVE A NATURAL EFFICIENCY ADVANTAGE.

- *DIRECT HEATING OF HOT OIL*
- *ELIMINATION OF ENERGY TRANSITION LOSSES*

8 FT. X 24 FT. PROTOTYPE MIRROR

PRODUCTION MIRRORS - 14 FT. X 40 FT or 15 FT. X 40 FT.

MIRROR IS HYDRAULICALLY POSITIONED.

SOFTWARE

SOLAR TRACKING (MIRROR POSITION)

HEAT INPUT (TEMP. MODULATION)

SAFETY FUNCTIONS

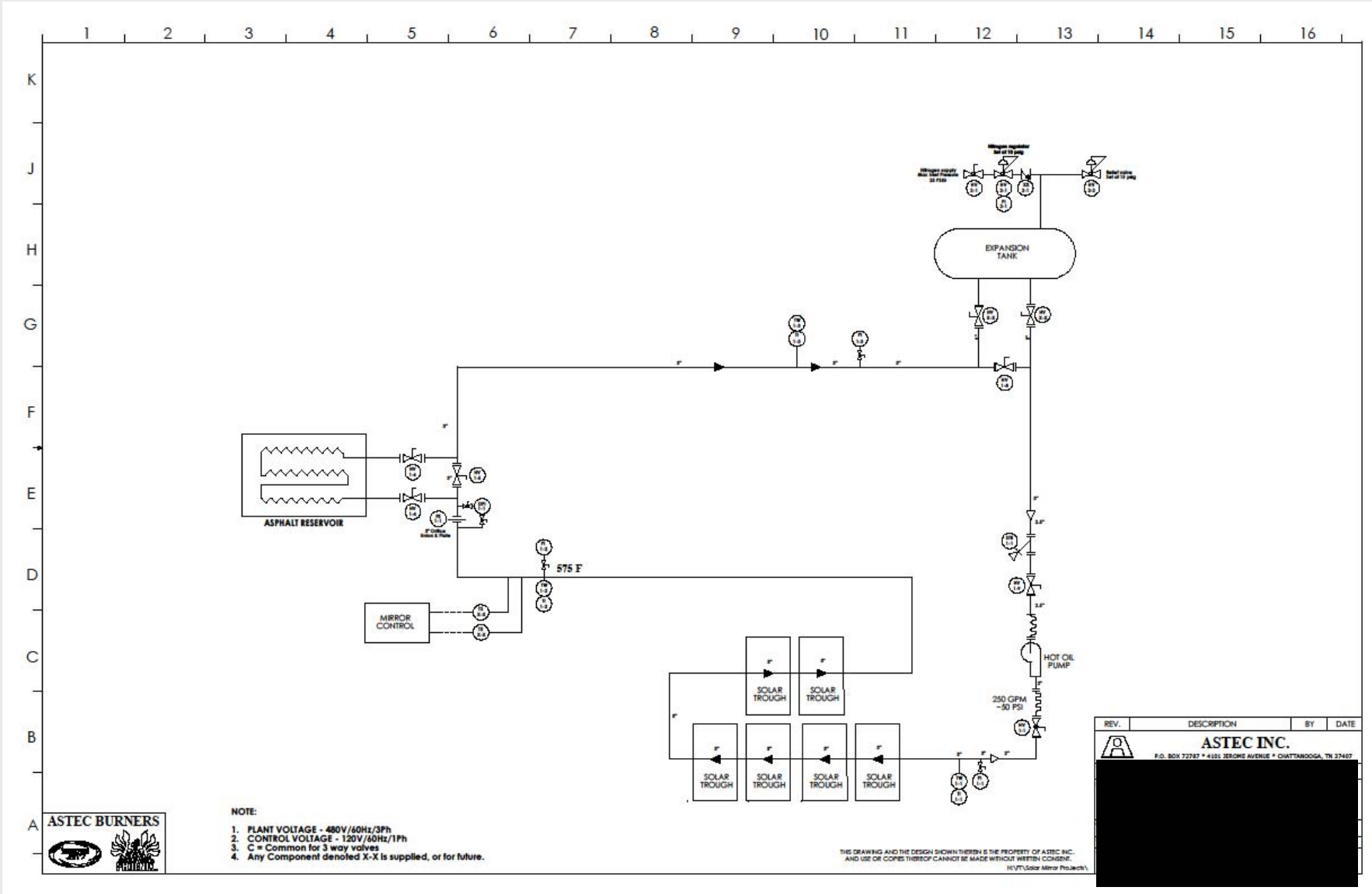
HOW CAN CAPTURED SOLAR HEAT BE USED IN ASPHALT APPLICATIONS?

1. *SUPPLY HEAT TO THE PLANT HOT OIL SYSTEM.*
2. *SUPPLY HEAT TO ASPHALT TERMINAL.*
3. *PRE-DRY RAP.*
4. *PRE-DRY AGGREGATE.*

ASPHALT APPLICATIONS ARE FUNDAMENTALLY VERY SIMPLE AND CONSIST OF JUST A FEW ELEMENTS.

1. *PARABOLIC MIRROR ASSEMBLIES*
2. *PUMP AND PIPING LOOP*
3. *EXPANSION TANK (FOR LARGE SYSTEMS)*
4. *MIXING VALVE OR HEAT EXCHANGER*

ASPHALT TERMINAL SYSTEM SCHEMATIC



HOW MANY MIRRORS ARE NEEDED?

DEPENDS ON AVAILABLE SUN AND SYSTEM HEAT LOAD.

A PLANT TANK FARM IN ARIZONA WOULD PROBABLY ONLY NEED 2 OR 3 MIRRORS.

AN ASPHALT TERMINAL IN THE SAME AREA MIGHT NEED 6 OR 8 MIRRORS.

A PLANT TANK FARM IN THE CINCINNATI AREA MIGHT NEED 4 OR 5 MIRRORS.

HOW ABOUT OVERALL SYSTEM EFFICIENCY?

IF WELL INSULATED, 65% OVERALL EFFICIENCY WOULD BE A REASONABLE EXPECTATION.

ECONOMIC FEASIBILITY

HOW CAN YOU DETERMINE WHETHER YOUR PROJECT IS ECONOMICALLY FEASIBLE?

USE LIFECYCLE COST ANALYSIS
OR
LIFECYCLE COST BREAK EVEN ANALYSIS.

CAPITAL EQUIPMENT COSTS

- PURCHASED EQUIPMENT FOR SOLAR
- AVOIDED PURCHASE OF CONVENTIONAL

CONSIDER INCENTIVES IN THE ANALYSIS.

INCENTIVES

30% FED. INVESTMENT TAX CREDIT OR U. S. TREASURY GRANT, WITH NO MAXIMUM LIMIT, IS AVAILABLE IN ALL STATES.

DATABASE FOR INCENTIVES
FOR RENEWABLES AND EFFICIENCY

www.dsireusa.org/incentives

ENERGY COST

AVOIDED FUEL PURCHASES

AVOIDED ELECTRICITY PURCHASES

MAINTENANCE COST

- *TUNING, CLEANING, REPAIR OF CONVENTIONAL HEATERS*
- *CLEANING, PREVENTIVE MAINTENANCE, AND REPAIR OF MIRROR SYSEMS.*

CST vs FOSSIL FUEL HEAT BREAK EVEN POINTS

LOCATION	**#2 OIL**	**NAT. GAS**
LAS VEGAS, NV	$0.46/GAL	$3.60/MMBTU
TAMPA, FL	$0.55/GAL	$4.30/MMBTU
EL PASO, TX	$0.60/GAL	$4.70/MMBTU
STOCKTON, CA	$0.64/GAL	$5.00/MMBTU
KANSAS CITY, MO	$1.56/GAL	$12.20/MMBTU
CINCINNATI, OH	$2.11/GAL	$16.46/MMBTU