



# Low/No Cost Energy Savings Solutions

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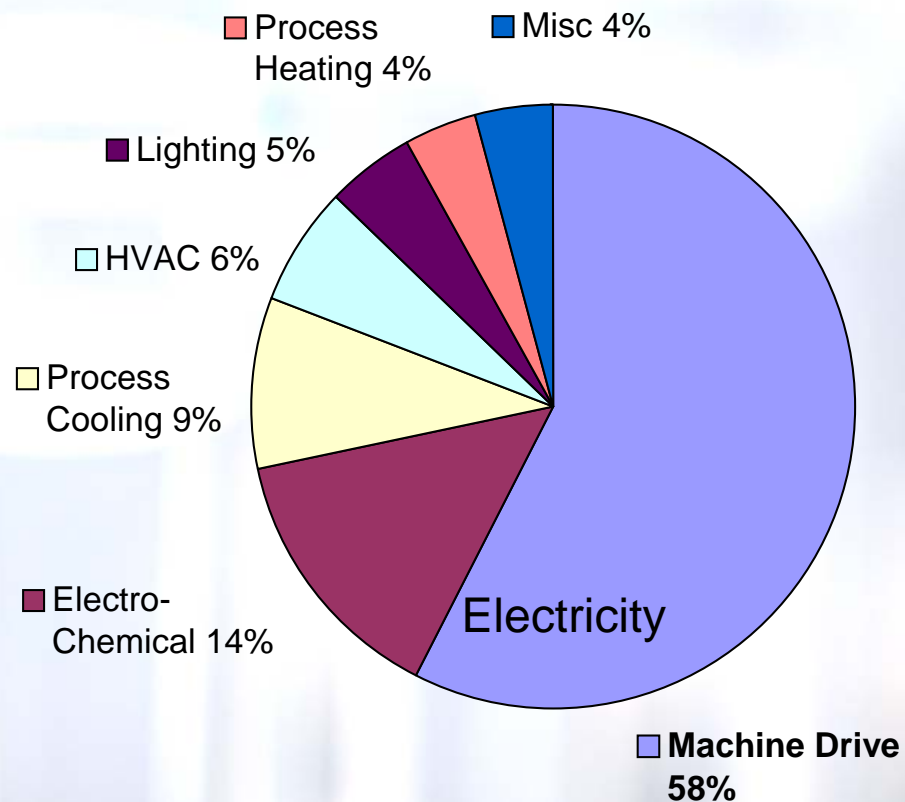
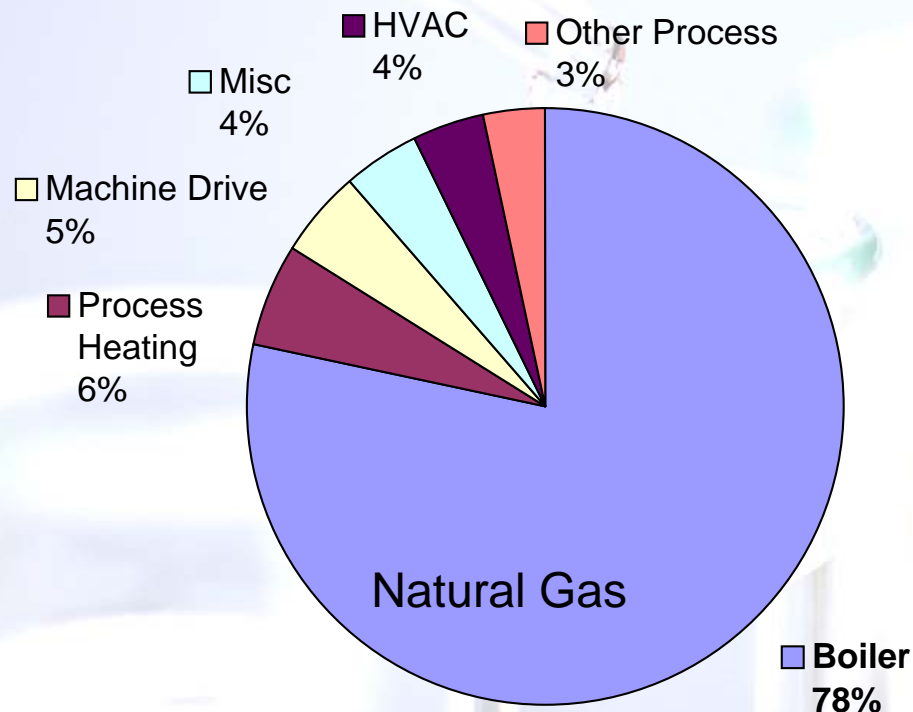


# Energy Resources Center Audit Experience

- ERC/IAC
  - 50 Chemicals Industry audits since 1999
  - Over 700 cost reduction recommendations



# Chemical Industry Energy Usage



Source: EIA Manufacturing Energy Consumption Survey (MECS) <http://www.eia.doe.gov/emeu/mecs/contents.html>



# Low Hanging Fruit

## ■ Boilers/Steam

- Combustion Efficiency (Don't forget Process Heating!)
- Steam Leaks
- Steam Traps
- Insulation

## ■ Machine Drive

- High Efficiency Motor Program
- Load Shifting
- Compressed Air Leaks
- Reduce Compressed Air Pressure



# Combustion Efficiency

- In theory . . .

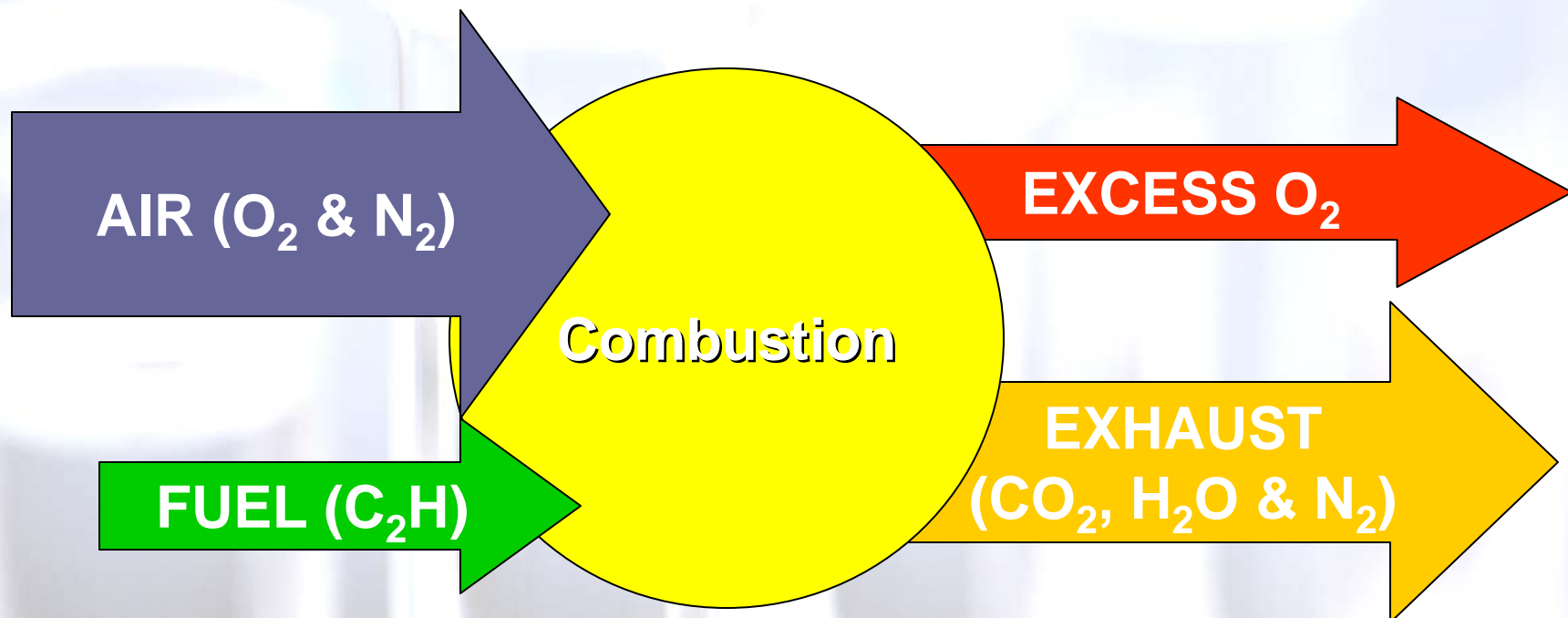




# Combustion Efficiency

- In the real world . . .

Excess air introduced to prevent incomplete combustion



*Left over oxygen carries heat away from boiler*



# Combustion Efficiency

- Boiler service company can test efficiency and tune burner
- Typical improvements: 2% to 5% boiler energy reduction



# Steam Leaks

- Easy to find
- Hard to fix



Steam Leak Rates Through Holes (lbm/hr)													
Orifice Diameter (inches)	Steam Pressure (psig)												
	2	5	10	15	25	50	75	100	125	150	200	250	300
1/32	0.31	0.49	0.7	0.85	1.14	1.86	2.58	3.3	4.02	4.74	6.17	7.61	4.05
1/16	1.25	1.97	2.8	3.4	4.6	7.4	10.3	13.2	16.1	18.9	24.7	30.4	36.2
3/32	2.81	4.44	6.3	7.7	10.3	16.7	15.4	29.7	36.2	42.6	55.6	68.5	81.5
1/8	4.5	7.9	11.2	13.7	18.3	29.8	41.3	52.8	64.3	75.8	99	122	145
5/32	7.8	12.3	17.4	21.3	28.5	46.5	64.5	82.5	100	118	154	190	226
3/16	11.2	17.7	25.1	30.7	41.1	67	93	119	145	170	222	274	326
7/32	15.3	24.2	34.2	41.9	55.9	91.2	126	162	197	232	303	373	443
1/4	20	31.6	44.6	54.7	73.1	119	165	211	257	303	395	487	579
9/32	25.2	39.9	56.5	69.2	92.5	151	209	267	325	384	500	617	733
5/16	31.2	49.3	69.7	85.4	114	186	258	330	402	474	617	761	905
11/32	37.7	59.6	84.4	103	138	225	312	399	486	573	747	921	1095
3/8	44.9	71	100	123	164	268	371	475	578	682	889	1096	1303
13/32	52.7	83.3	118	144	193	314	436	557	679	800	1043	1286	1529
7/16	61.1	96.6	137	167	224	365	506	647	787	928	1210	1492	1774
15/32	70.2	111	157	192	257	419	580	742	904	1065	1389	1713	2037
1/2	79.8	126	179	219	292	476	660	844	1028	1212	1580	1949	2317

*The table can also be used to determine steam losses through steam traps that have failed open.*



# Steam traps

- Expect 15% to 30% failure every 3 to 5 years
- Easily tested using ultrasonic equipment
- Should be tested at least annually



15% x 200 traps x 30 lbs/hr x 8,760 hrs x \$7.50/lb

**= \$51,000/yr**



# Insulation

- Lack of insulation → unnecessary heat loss
- Wet insulation → heat loss
- Condensate return lines need insulation too.
- 3E Plus available at [www.pipeinsulation.org](http://www.pipeinsulation.org)

Steam Pressure (psig)	Pipe Diameter (inches)	Bare Pipe Losses (Btu/ft/hr)	1.5" Insulated Loss (Btu/ft/hr)	Annual Savings per 100 ft*
150	4	1,050	88	\$4,941
150	2	580	57	\$2,729
100	4	903	78	\$4,249
100	2	499	50	\$2,339
50	4	699	62	\$3,289
50	2	387	39	\$1,821

\*Based on 8,000 hours of operation, 85% efficient boiler, mineral fiber insulation with all purpose jacket



# High Efficiency Motor Program

## ■ Motor Replacement/Rewind Policy

- Rewind or replace?
- Right size?
- High efficiency?
- Appropriate controls?

## ■ MotorMaster+ 4.0

	Existing <Avg Std Efficiency>	Premium Efficiency <Avg Premium Efficiency>
Size/Speed	200 hp 1200 RPM	200 hp 1200 RPM
Enclosure/Voltage	TEFC 460 Volts	TEFC 460 Volts
Hours use/yr	8760	8760
Load (%)	75.0	75.0
Efficiency (%)	93.2	95.7
Full load RPM		
Old Motor Effic Loss		
Dealer discount (%)		25.0
Purchase Price (\$)		13409
Installation Cost (\$)		650
Motor Rebate (\$)		
Peak Months	12	12



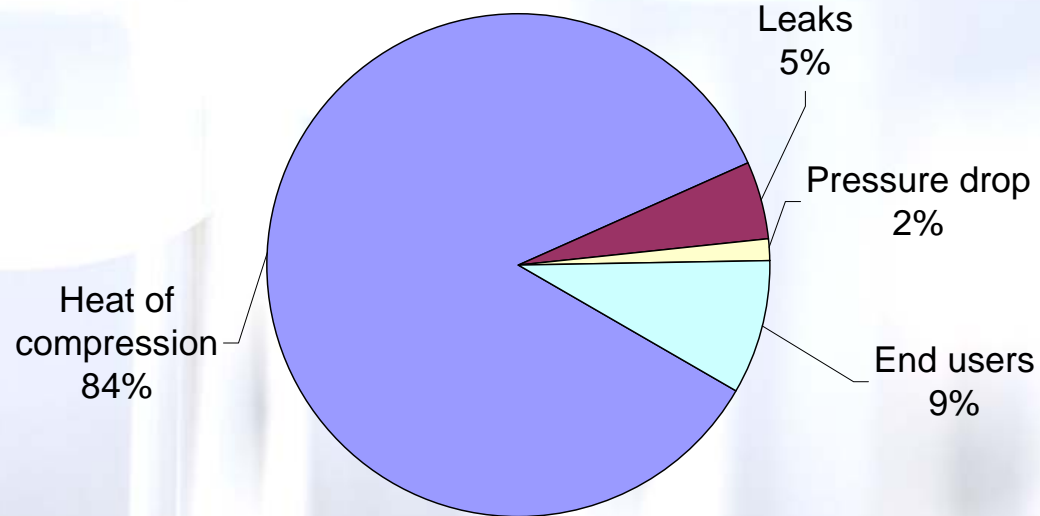
# Off-Peak Load Scheduling

- Off-Peak energy is generally less expensive
- Typically no demand charges off-peak
- Can any periodic & energy intensive loads be done off-peak?
  - Pumping systems
  - Blower systems
  - Clean-up operations
  - Process start-up
  - Compressed air intensive processes
- Can entire production processes be done off-peak?



# Compressed Air Energy

- Inefficient power source even if perfectly maintained



**9% System Efficiency**



# Compressed Air Leaks

- When was your last leak survey?
- Poorly maintained systems
  - Up to 40% leak rate
  - Pressure problems
  - “We need to install another compressor.”



# Reduce Compressed Air Pressure

- Why is your pressure set where it is?
- Have you ever tried to turn it down?
- 1% pressure reduction → 1/2% energy reduction
- 5 psig reduction at a time



# Assessing your current systems

- Self assessment
  - Tools available from US DOE
- US DOE Industrial Assessment Centers
- Energy Resources Center @ UIC
- Private energy service companies
- Equipment manufacturers



U.S. Department of Energy  
**Energy Efficiency and Renewable Energy**

