

Energy Recovery
Resource Conservation Plan
MADICO, Woburn, MA

Presented By: Sandra Wyman, P.E. TUR/RC Planner

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TUR Planner Continuing Education Conference
Sheraton Hotel and Conference Center, Framingham, MA

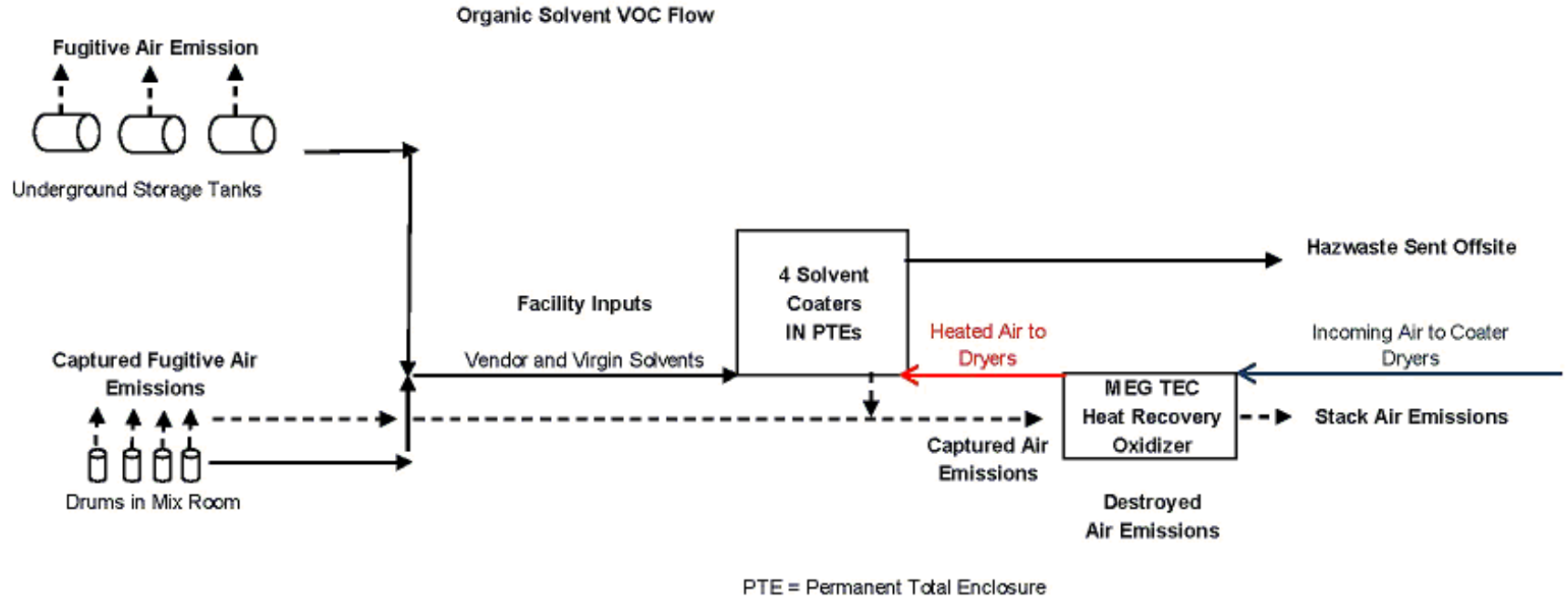
MADICO - Company Overview

- Subsidiary of LINTEC Worldwide
- Solvent based coating of polymer films
- Products include security, window, and photovoltaic panel films
- Four coaters used; one a pilot coater for research
- Installed MEGTEC RTO (regenerative thermal oxidizer) in 2002
- Elected in 2009 to do an RC Plan, focusing on energy
 - The facility had done a number of TUR Plans
 - The facility had done several projects in energy conservation
 - Energy is major production cost

RC Planning Team

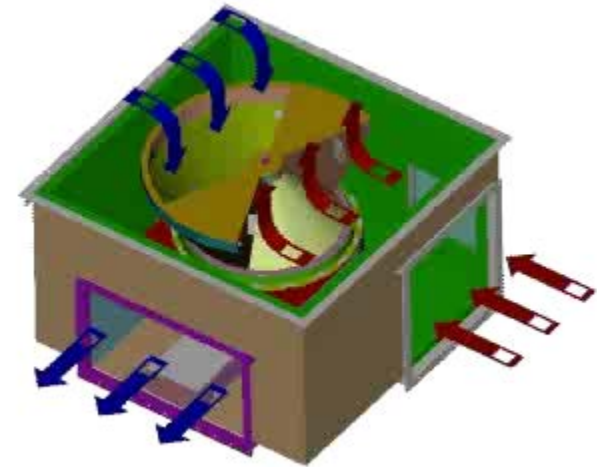
- The TUR Team consisted of: Mark Felhmann, Director of Engineering, Paul Malburg, Facilities Engineer, George Zanni, EHS Manager, and Sandra Wyman, P.E. , TUR / RC Planner
- Two rounds of meetings
- First focused on benchmarking
- Second on options

Overview of Process



MEGTEC RTO

<http://www.megtec.com/regenerative-thermal-oxidizers.html>



Heat of Combustion

- Solvents used in the process have a higher BTU content than natural gas—depends on SLA composition
 - 1,000 BTUs/CF natural gas
 - 3,341 BTUs/CF solvent laden air (SLA)
 - 3.34 more BTUs in SLA
- Solvents cost more than natural gas, but are already employed in the process, so the heat value is a “bonus”
 - \$11/MM BTU natural gas (@ \$1.10/therm)
 - ~\$39/MM BTU SLA (depends on solvent mix)
 - SLA 3.55 more in cost

Benchmarking

- MA DEP said credit could be taken for previous energy conservation efforts
- The team wanted to review from 2002 forward
- Utility records were analyzed against various production data to find the appropriate metric for normalizing energy use
- Statistics were used; correlation coefficients were calculated
- Natural gas therms and electricity kWhrs uses were reviewed
- Production data used to normalize energy consumption:
 - Operating hours
 - Square foot coated product
 - Tons VOC [Volatile Organic Compound/Solvent] used
 - Heating Degree Days (HDD)
- An *enigma* emerged

Statistics

- Central limit theorem
- 30 data pairs to be statistically significant
- Excel spreadsheet can be used for calculating correlation coefficients
- The correlation coefficient, r^2 , should be as close to 1.0 as possible, either positive or negative
- A correlation coefficient of 0.90 means 90% of the time, the data pairs track with one another

Heating Degree Days (HDDs)

- Mathematically: $\text{HDDs} = 65 \text{ F} - \text{daily mean temp F}$
- On March 26th, the mean temperature was 35 F where I live, so the HDDs were 30 for that day
- HDDs are summed monthly on most weather data tracking sites
- Weatherunderground.com is one website where you can find HDDs for your area by zip code

Don't get me started...

	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988
JAN	1,174	1,343	1234	1,464	1,183	1,206	1,068	1,410	1,540	1,563	1,066	1,371	1,341	1,314	1,164	1,284	1,343	1,167	1,577	1,280	1,268	1,283	1,071	1,174	1,339	
FEB	993	1,153	953	1,087	1,126	1,276	1,088	1,009	1,128	1,246	1,006	1,136	1,113	1,002	938	1,180	1,181	1,216	1,266	1,344	1,127	979	1,093	1,141	1,130	
MAR	732	974	773	986	1,015	1,012	937	1,074	1,198	1,028	927	1,067	838	903	872	1,065	1,083	929	968	1,084	1,051	861	935	1,028	950	
APR	536	599	478	544	598	689	575	596	609	717	609	643	645	599	569	689	659	706	609	645	700	568	607	708	641	
MAY	264	327	235	361	331	295	324	477	329	391	380	330	361	322	264	424	384	391	389	311	414	236	402	286	323	
JUNE	116	105	78	120	60	101	64	100	159	114	149	57	112	61	143	135	90	85	61	81	84	76	107	91	112	
JULY	0	0	9	41	0	17	0	17	15	9	23	32	11	6	3	11	23	9	1	15	47	11	12	6	13	
AUGUST	0	3	9	27	23	38	43	8	20	22	21	15	18	23	9	21	17	35	35	5	30	16	24	25	32	
SEPT	166	102	112	183	162	147	148	85	131	110	103	140	184	104	123	192	179	265	201	173	208	228	170	167	180	
OCT	366	416	480	357	495	348	491	454	470	521	563	456	491	562	482	554	556	384	472	575	543	433	388	464	569	
NOV		600	736	651	764	814	630	723	776	719	830	702	729	686	761	857	899	873	695	774	814	730	690	824	713	
DEC		971	1103	1,101	1,121	1,213	939	1,146	1,140	1,088	1,158	928	1,240	1,020	1,002	1,093	940	1,247	1,027	1,080	1,112	1,191	964	1,573	1,201	
TOTAL	4,347	6,593	6,200	6,922	6,878	7,156	6,307	7,099	7,515	7,528	6,835	6,877	7,083	6,602	6,330	7,505	7,354	7,307	7,301	7,367	7,398	6,612	6,463	7,487	7,203	

24 year average

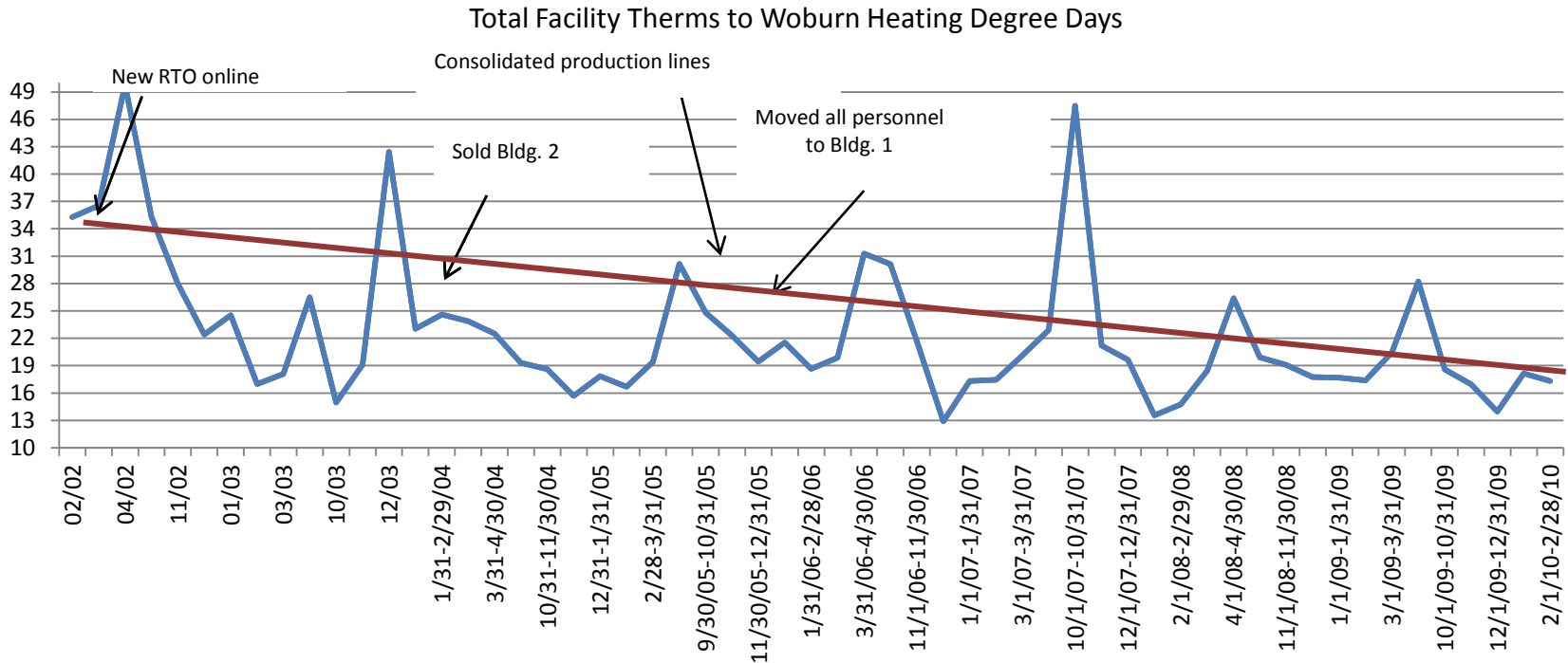
6,997

<http://www.weather.gov/climate/index.php?wfo=gyx>

Finding Best Benchmarks

- Facility Kwhrs to Operating Hours r^2 correlation coefficient = 0.63
- Facility Therms to Operating Hours r^2 correlation coefficient = -0.13 [*OTW?*]
- Facility VOC use to Operating Hours r^2 correlation coefficient = 0.88
- Facility Therms to Woburn HDDs r^2 correlation coefficient = 0.79

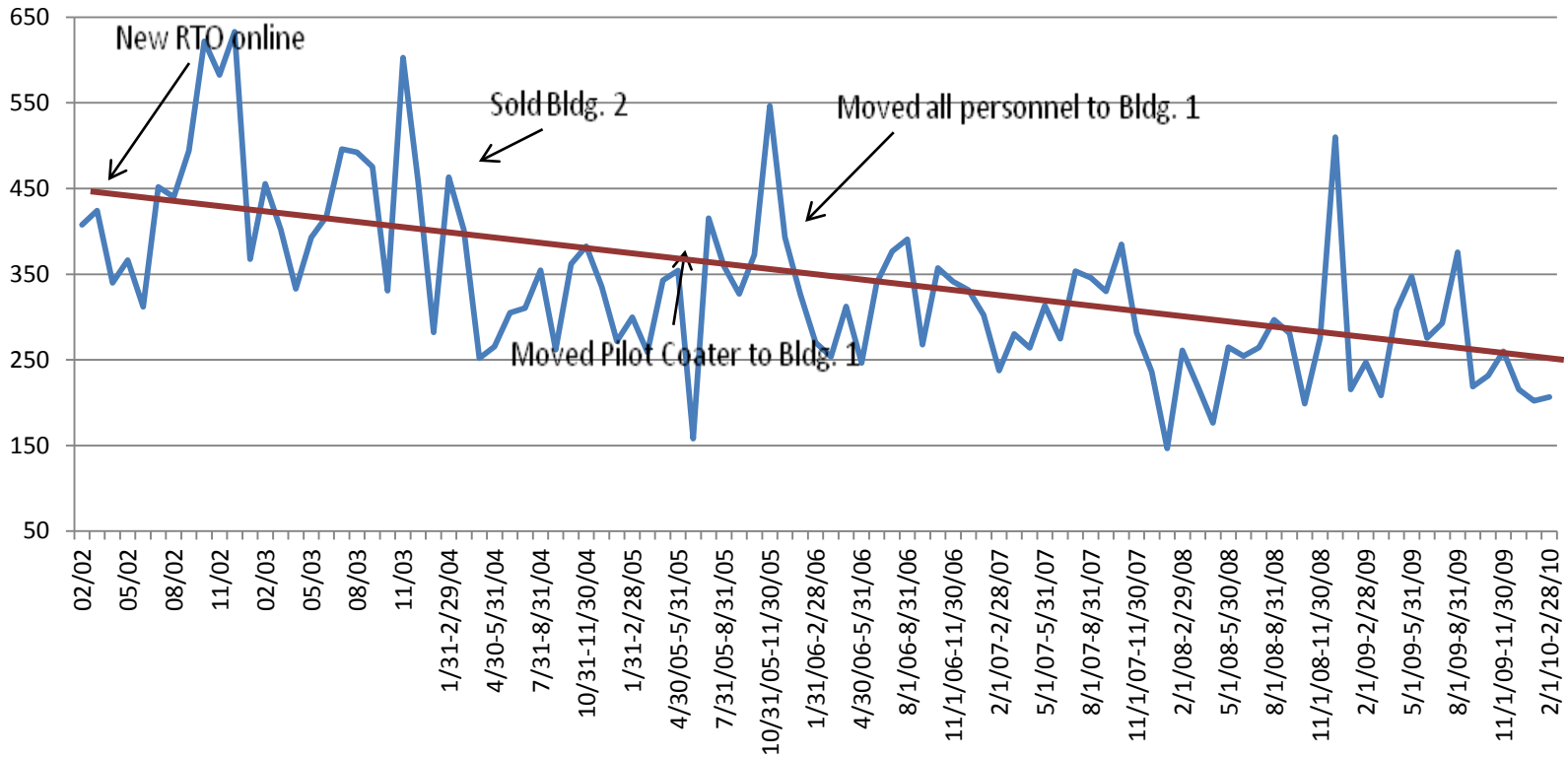
Charted Metrics



The benchmark Natural Gas Therms/Woburn Heating Degree Days reflects an average 53% drop from 34 to 16. Key projects that account for the decreased energy use are noted.

Charted Metrics

Total Kwhrs to Operating Hours



From 2002-2010, the electricity benchmark of kwhrs/operating hours dropped from 450 to 250, or 44%.

Earlier Energy Conservation Efforts

Option	Annual Energy Change (Kwhrs)	Annual Energy Change (Therms)	Annual Cost Savings	Reduction in CO2 Footprint (tons/year)
Old Oxidizer Retired Subtotal	-28,970,076	-988,459	\$1,285,000	5,931
2002-2009 Facility Consolidation Subtotal	-2,201,995	-75,132	\$97,672	451

Future Energy Conservation Options

Option	Annual Energy Change (Kwhrs)	Annual Energy Change (Therms)	Annual Cost Savings	Reduction in CO2 Footprint (tons/year)
Air balancing	-395,076	-13,480	\$18,880	
Replace air compressor	-197,759	-6,750	\$35,596	
Evaluate chiller	-38,510	-1310	\$6,932	
Improve lighting	-19,520	-670	\$3,514	
Future Projects Subtotal	-650,865	-22,210	\$64,922	133
Past and Future Total	-31,822,936	-1,085,801	\$1,447,594	6,515

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Grand Total	-31,822,936	-1,085,801	\$1,447,594	6,515

*@ \$1.30/therm up to 2009; cost savings are higher for future projects due to reduction in electricity use along with natural gas use; electricity cost is higher than natural gas.

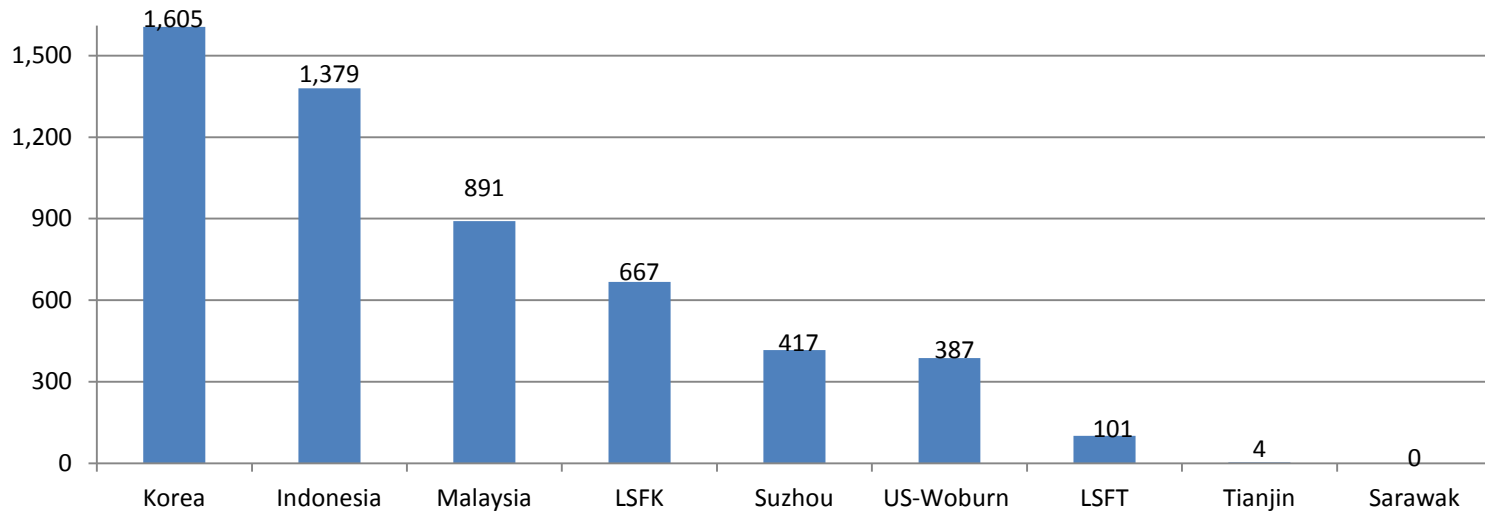
\$222 saved for each ton of CO2 reduction!

RTO Impact on Natural Gas Use

		Post RTO	Therms
		2002	218,536
		2003	179,206
Pre RTO	Therms	2004	161,886
1996	1,252,070	2005	162,881
1997	1,225,452	2006	147,052
1998	1,083,037	2007	164,216
1999	1,065,755	2008	132,565
2000	1,064,028	2009	142,310
2001	1,221,901	Average	163,582
Average	1,152,041		
Difference			988,459
			-86%

Lintec Worldwide – Fossil Fuel Use As KL Oil

2009 KLs Used*



Notes	
LSFK = Lintec Specialty Films Korea	
LSFT = Lintec Specialty Films Taiwan	
* 139,000 BTU/gal crude oil	
* 1000 BTU/cubic foot natural gas	
* 3.78 liters per gal	
* 2009 Woburn Million (MM) BTUS Natural Gas Used	14,231
* 2009 Woburn Equivalent Crude Oil Used - Gals	102,381
* 2009 Woburn Equivalent Crude Oil Used - KLs	387

Historical Production Trends

- Operating hours increased 14% from 2002-2009, an average of 2% per year.
- On a square footage basis, production square feet increased 905% from 2002 – 2009, an average of 129% per year.
- Environmental stewardship and productivity can coexist!

RC Planning

- Three cycles have passed, 2007, 2009, and 2011
- Of ~580 MA TUR filers, 29 companies did an RC plan in 2007 and 14 did one in 2009
- For energy conservation, no facilities filed in 2007, and 9 facilities filed in 2009
- Progress reports for latest round were submitted this year

RC Planning Summary

	2007 & 2009	Units
No. Energy RC Plan Filers	23	
Baseline energy	313	kwhrs
Est'd energy reductions	58	kwhrs
Avg reduction	19%	
No. Water RC Plan Filers	8	
Baseline water	370	million gpy
Est'd reductions	38	million gpy
Avg reduction	10%	
No. Solid Waste RC Plan Filers	5	
Baseline solid waste	3,245,000	lbs/year
Est'd reductions	860,000	lbs/year
Avg reduction	27%	
No. Exempt/Below Threshold Chems. RC Plan Filers	7	
Baseline use	45,000	lbs/year
Est'd reductions	11,000	lbs/year
Avg reduction	24%	

Benefits of Energy RC Planning

- Data to take to the utilities for funding projects
- Documentation of reduction in carbon footprint
- Cost savings
- Knowledge-- you can't save what you don't measure
- A break from chemical TUR Planning!

Questions?

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