Energy Audit Case-Study

ENERCO ENERGY SOLUTIONS LLP
(WWW.ECONSERVE.IN)

ENERGY AUDIT CASE-STUDY

AGENDA

- About the Customer
- About the Energy Audit
- Energy Audit Findings

About the Customer

European MNC and top manufacturer of Sanitary Products

Several plants across India with presence in 130+ Countries

Energy Cost was forming a significant part of total cost of production

Urgent need to save Energy for cost-benefit + as a sustainability measure

Management realized **Energy Audit** as the 1st crucial step

About the Customer

Objectives of Energy Audit

- Become **cost-efficient** in an ever-competing market and gain market-share
- Reduce energy consumption through Energy Conservation
- Adopt newer methodologies for improving Energy Efficiency
- Take a step towards sustainability and ***Green Quotient*** of the Company
- Create a culture of Energy Optimization in the plant work-force

About the Energy Audit

- **ENERCO Energy Solutions LLP (Estd. 2009)** specializes in **Industrial Energy Audit** and **Solar Power – Financing & Execution**
- **Clients**

CEAT

vedanta

Reliance Industries Limited

Finolex

future group
india tomorrow

And Many More…..

About the Energy Audit

- **ENERCO Energy Solutions LLP** approached the customer with a proposal for –
  - **Demand Side Management : Energy Optimization**
  - **Green Power Generation : Onsite Solar Power**
- A joint road-map was drafted and approved including the Scope, Duration, Methodology and Approach

About the Energy Audit

- **Energy Audit approach**
  - **Phase 1 : Pre-visit**
    - Energy details of the plant were analyzed 10 days prior to the visit
  - **Phase 2 : Site Visit**
    - B.E.E. Certified (IIT-B alumnus) Energy Auditor led a team of 4 Senior engineers for site visit for a period of 10 days
    - All the electrical and mechanical utilities, equipment, systems and processes were studied and measurements carried out during the visit

About the Energy Audit

- **Energy Audit approach (contd.)**
  - **Phase 2 : Site visit (contd.)**
    - Daily briefing and discussions with Customer team
    - Visit concluded with final presentation + findings
  - **Phase 3 : Post-visit (offsite Report preparation)**
    - Data analysis and calculations for Draft Report submission
    - Draft Report submitted in 3 weeks and finalized in 1 week after plant feedback

About the Energy Audit

Conclusion

- Customer extremely satisfied with the findings of energy audit with expected ***10% reduction in energy bills and 2.5% reduction in total production cost***
- All the recommendations were given with an attractive payback ranging between ***ZERO months and 17 months with average of 9 months***
- Solar Project (***financed by Enerco***) was taken up post the findings under the ***customized financial model*** recommended and proposed by Enerco
- Testimonial / Reference letter given to Enerco + Energy Audit assignment of other plants

ENERGY AUDIT FINDINGS

- Tunnel Kiln
- Shuttle Kiln
- LPG
- Fan
- Compressors
- Demand Management
- DG Set
- Cable Loss

ENERGY AUDIT FINDINGS

<u>Important</u> – Please do not carry out any recommendations mentioned herein without due-diligence or study.

Enerco Energy Solutions LLP cannot be held liable for the outcome of any such implementation.

TUNNEL KILN COMBUSTION EFFICIENCY

- The combustion flow air is very high with 17.5% Oxygen in flue gas; against typical range of 3.0 to 5.0%.
- This could partially be due to ingress of uncontrolled quantity of rapid cooling air in to the combustion zone.

Suggestions:

- Maintain & Control Pressures at the rapid cooling & Combustion / Soaking zones to optimize the air ingress.
- Consider providing air curtain to minimize air ingress
- Monitor flue gas parameters at various stages.

TUNNEL KILN COMBUSTION EFFICIENCY

Parameter	Unit	Tunnel Kiln	
		Present	Projected
Specific Fuel	kg/kg of NP	136	114.9
Fuel Consumption	Ton/Year	1004.7	848.9
Combustion Efficiency			
O_2 in Flue Gas	%	17.5%	8.0%
CO in Flue Gas	%	0.000%	0.000%
Flue Gas Temperature	°C	117.0	117.0
Net Loss and efficiency			
Net Loss	%	27.2%	13.8%
Efficiency (GCV basis)	%	72.8%	86.2%
Saving Potential			
Effective savings	kg/day	Base	463.9
Economics: Optimizing heat loss through kiln exhaust			
Cost of fuel	Rs/kg	44.6	
Projected saving	kg/day	463.9	
	Ton/Year	155.79	
	Rs/Year	6948100	
Investment	Rs	2000000	
Payback Period	Months	3.5	

SHUTTLE KILN COMBUSTION EFFICIENCY

- The combustion flow air is very high with 11.2 to 18.9% Oxygen in flue gas; against typical range of 3.0 to 5.0%.
- The carbon monoxide contents are higher despite higher air flow; implying need of correction on burners side.

Suggestions:

- Consider stoppage of air flow through unfired burners.
- Monitor flue gas parameters at various stages.
- Consider monitoring furnace pressure with draught control mechanism.

SHUTTLE KILN COMBUSTION EFFICIENCY

Parameter	Unit	4 Burners		8 Burners		16 Burners	
		Present	Projected	Present	Projected	Present	Projected
Fuel Consumption	kg/Batch	44.9	27.5	227.8	165.4	331.3	241.7
O_2 in Flue Gas	%	18.9%	8.0%	11.6%	8.0%	11.2%	8.0%
CO in Flue Gas	%	0.009%	0.009%	0.500%	0.020%	0.500%	0.020%
Flue Gas Temperature	°C	141.0	141.0	600.0	600.0	650.0	650.0
Net Loss and efficiency							
Net Loss	%	48.2%	15.3%	59.1%	43.6%	61.1%	46.7%
Efficiency (GCV basis)	%	51.8%	84.7%	40.9%	56.4%	38.9%	53.3%
Saving Potential							
Effective savings	kg/Batch		17.4		62.4		89.7
Economics: Optimizing heat loss through kiln exhau							
Cost of fuel	Rs/kg	44.60					
Projected saving	kg/day	169.43					
	Ton/Year	68.19					
	Rs/Year	3041000					
Investment	Rs	1000000					
Payback Period	Months	3.95					

HEAT PUMPS FOR LPG HEATERS IN ECS BLOWERS

- A considerable quantity (around 478 Ton during previous year) of LPG is utilized for drying molds; by generating hot air at 45 to 50 ^{o}C in ECS fan system.

Suggestions:

- Consider replacing LPG heating with heat pumps to generate requisite hot air.
- The heat pumps typically has a energy efficiency ratio between 3.6 to 4.0; effectively reducing operating costs.
- If required chilled air or water can also be generated with small incremental costs.

HEAT PUMPS FOR LPG HEATERS IN ECS BLOWERS

Description	Unit	Value
Overall Parameters		
Consumption of LPG	Ton/Y	478.2
Operation	Hr/day	10
	Day/Year	330
Present cost of operation		
Cost of operation	Rs/Year	21328100
Power for Equivalent Output		
Power for heat pump	kW	470.0
Power for Auxiliary	kW	30.0
Total Power	kW	500.0
Expected power	kWh/Year	1650000
	Rs/year	14025000
Saving Potential		
Cost of power	Rs/KWH	8.5
Cost of LPG	Rs/kg	44.6
Expected Gains	Rs/Year	7303100
	%	34.2%
Investment	Rs	10000000
Payback Period	Months	16.4

FAN PERFORMANCE IMPROVEMENT

- The performance of many of the fans is on the lower side
- The lack of design data & details pos restrictions while suggesting remedial measures.

Suggestions:

- Consider overhauling the blowers.
- Replace the xxx

FAN PERFORMANCE IMPROVEMENT

Description	Unit	Battery Casting	TK3	
		ECS Fan-2	ECS Fan-1	ECS Fan-2
Actual Parameter				
Flow rate	M^3/hr	36480	8086	7245
Differential Pr - Static	mm WC	28	17	22
Motor Power	kW	6.9	2.3	2.6
Static efficiency	%	45.4%	18.5%	18.4%
Projected Parameters				
Efficiency	%	65.0%	55.0%	55.0%
Controllable Losses				
Controllable Losses	kW	2.1	1.5	1.7
Saving Potential & Economics				
Cost of Power	Rs/kWh	8.50	8.50	8.50
Operating Period	Hr/Day	5	5	5
	Day/Y	350	350	350
Saving	kWh/Y	3634.8	2623.7	3018.9
	Rs/Y	30800	22300	25600
Investment	Rs	50000	25000.0	25000.0
Payback period	Month	19.5	13.5	11.7

FAN PERFORMANCE IMPROVEMENT

Description	Unit	Battery Casting	Mould Dryer	Shutter kiln
		ECS Fan-1	Fan-3	Burner Air Fan
Actual Parameter				
Flow rate	M^3/hr	31104	5289	2419
Differential Pr - Static	mm WC	37	101	237
Motor Power	kW	7.8	4.0	4.5
Static efficiency	%	44.9%	40.5%	38.5%
Projected Parameters				
Efficiency	%	65.0%	55.0%	55.0%
Controllable Losses				
Controllable Losses	kW	2.4	1.1	1.3
Saving Potential & Economics				
Cost of Power	Rs/kWh	8.50	8.50	8.50
Operating Period	Hr/Day	5	5	16
	Day/Y	350	350	350
Saving	kWh/Y	4204.4	1844.1	7557.9
	Rs/Y	35700	15600	64200
Investment	Rs	50000	25000.0	25000.0
Payback period	Month	16.8	19.2	4.7

AIR COMPRESSOR VFD BASED OPERATION

- The operating load on the compressors is about 70%; leading to unload operation & related losses.
- The VFD based control provided for Compressor 2 has been bypassed due to maintenance issues.

Suggestions:

- Consider rectifying & making operational VFD based operation for Compressor 2.
- Maximize operation of the compressor with xxxx to eliminate losses.

AIR COMPRESSOR VFD BASED OPERATION

Description	Unit	Air Compressor Room		
		Compressor 1	Compressor 2	Compressor 3
Flow Rate	M^3/hr	577.7	510.0	280.0
Loading Power	kW	55.9	55.9	36.1
Unloading Power	kW	10.8	14.5	6.4
Operating Load				
Effective Utilization	%	73%	70%	74%
Un-load Loss	kWh/Y	5160	7496	1729
Saving Potential & Economics				
Cost of Power	Rs/kWh	8.5	8.5	8.5
Operating Period	Hr/Day	5	5	3
	Day/Y	330	330	330
Saving	kWh/Y	5159.7	7495.8	1729.3
	Rs/Y	43754.3	635.6	146.6
Saving Potential	kWh/Y	14384.8		
	Rs/Y	44500		
Investment	Rs	0.0		
Payback period	Month			

Demand Management & Reduction

- The billed demand is considerably higher than actual demand due to lower operating load and higher contract demand.

Suggestions:

- Consider reducing contract demand to xxx kVA.
- Incorporate xxxxx to reduce demand below xxx kVA.

DEMAND MANAGEMENT & REDUCTION

Month	Present		Projected		Gains
	Actual	Billed	Billed	Reduction	Rs/Month
Jul-17	736	1080	736	344	120498
Aug-17	826	1080	826	254	88914
Sep-17	709	1080	720	360	126000
Oct-17	714	1080	720	360	126000
Nov-17	716	1080	720	360	126000
Dec-17	762	1080	762	318	111132
Jan-18	719	1080	720	360	126000
Feb-18	726	1080	726	354	123858
Mar-18	673	1080	720	360	126000
Apr-18	696	1080	720	360	126000
May-18	695	1080	720	360	126000
Jun-18	704	1080	720	360	126000
Overall	1080	1080	734	346	121000

UPS TO ELIMINATE DG OPERATION

- The casting section blower is operated on 40 KVA DG set, as a precautionary measure, to avoid production loss in case of power outage.

Suggestions:

- Consider installation of UPS with 15 minutes back up and present DG set as a back up power source.

UPS TO ELIMINATE DG OPERATION

Description	Unit	Value
Overall Parameters		
Power Generation	kW	9.5
HSD Consumption	L/hr	3.40
Operation	Hr/day	1.5
	Day/Year	330
Present cost of operation		
Cost of operation	Rs/Year	108890
Cost of operation with UPS		
Power	kW	9.5
Expected power consumption	kWh/Year	4703
	Rs/year	39971
Saving Potential		
Cost of power	Rs/KWH	8.5
Cost of HSD	Rs/kg	64.7
Expected Gains	Rs/Year	68900
	%	63.3%
Investment	Rs	100000
Payback Period	Months	17.4

Cable Loss Optimization

- The cable losses for Pump House & RO Plant panels are higher while the Power Factor is on the lower side.
- The losses are marginally higher at few places with higher PF; requiring load transfer / laying of additional cables; which may not be economical at present plant operation.

Suggestions:

- Xxxxx
- This would reduce current and bring down the cable losses.

CABLE LOSS OPTIMIZATION

Description	Phase	Power	Loss		Saving @ 0.9 PF	
		KW	%	KW	KW	%
Pump House	R	4.33	3.9%	0.17	0.094	55.6%
	Y	5.40	5.4%	0.29	0.115	39.5%
	B	5.25	2.7%	0.14	0.046	32.4%
RO Plant	R	17.6	2.3%	0.41	0.133	32.4%
	Y	16.6	2.0%	0.33	0.130	39.5%
	B	18.2	2.8%	0.50	0.190	37.8%
Controllable Losses						
Loss	kW	0.7				
Saving Potential & Economics						
Cost of power	Rs/kWh	8.5				
Operating Period	Hr/Day	8				
	Day/Y	350				
Saving	kWh/Y	1983.4				
	Rs/Y	16800				
Investment	Rs	15000				
Payback period	Month	10.7				

Overall Saving Potential

No	Description	Potential	Investment	Payback
		Rs / Year	Rs	Month
1	Improving & Maintaining combustion efficiency of tunnel kiln at optimal level	6948100	xxxx	3.5
2	Improving & Maintaining performance of the Shuttle Kiln at the optimal level	3040900	xxxxx	3.9
3	Replacing LPG firing for ECS fans (mould drying) with heat pump based system.	7303100	xxxxxx	16.4
4	Improving & Maintaining performance of various Fans & Blowers at optimal level	194200	Xxxxxxx	12.4

Overall Saving Potential

No	Description	Potential Rs / Year	Investment Rs	Payback Month
5	Eliminating unload loss by operating VFD based compressor in place of fixed speed compressors	44500	0	0.0
6	Optimizing peak demand through demand management & reducing the contract demand	121000	xxxxx	4.8
7	Reducing the cable losses by installing / repairing xxxx	16800	xxxxxx	10.7
8	Eliminating DG operation by installing UPS (backed with existing DG set) for the casting blower.	68900	xxxxxx	17.4
	Overall	**17651800**	**xxxxxx**	**9.2**

OBSERVATIONS

No	Description	Observations
1	Tunnel Kiln	The combustion efficiency is considerably lower due to very high excess air.
		The insulation appears to be satisfactory.
		The doors at the feed and product end need to be kept in closed condition except during material movement
		The hot air temperature appears to be lower, but major part of the heat is recovered for drying molds & greens.
2	Shuttle Kiln	The combustion efficiency is considerably lower due to very high excess air.
		The higher CO in flue gas (5000 against 200 ppm) indicate incomplete & improper combustion.
		The project to utilize the hot air during cooling for various drying applications is in the pipeline.
		The project to install Recuperator to preheat combustion air with flue gas during firing cycle is in the pipeline.
		The insulation appears to be satisfactory.
3	Direct Fired LPG Air Heaters for Mold Drying (for ECS	The possibility of further optimizing usage of hot air from Tunnel & Shuttle kilns may be assessed.
		Consider replacing LPG heaters with Heat Pumps.

OBSERVATIONS

No	Description	Observations
4	Fans & Blowers	The performance of many of the fans is on the lower side.
		Consult OEMs for design data as well as remedial measures.
		Overhaul the fans or replace them if economically viable;
5	Compressed Air System	The performance of the compressors is satisfactory.
		The possibility of setting right the VFD based compressor and maximizing the usage may be may be evaluated. This would minimize the unload losses.
		The system leakages are within the limit.
		The system pressure drop in within the standard norms
6	Ball Mills	Consider monitoring specific power & comparing the same with values generated with empirical values.
7	Illumination & Lighting	The illumination level is maintained as per the plant requirements.
		The light fittings are being replaced with LED lamps
8	Capacitors	Most of the capacitors are functioning properly.

OBSERVATIONS

No	Description	Observations
9	Electrical Motors & Drives	Most of the motors were observed to be loaded properly.
		The belt drives may be periodically inspected for slippage & other losses.
10	Transformers & Cablings	The transformer is operating at normal load.
		The cables losses are marginally higher at few places.
11	Demand Management	There is considerable gap in actual & bill demand.
		The actual demand can be further optimized through demand management
		consider reducing Contract Demand to around 800 kVA from the present value of 1200 kVA to save on demand charges
12	Power & Harmonics	The load shows variations, which is typical nature of the plant
		The load is more or less balanced among the three phases.
		The harmonic levels for voltage are within the stipulated values.
		The harmonic levels for current is marginally higher at 8 to 10% during lower load (night operation). The same is lower at 5% or less during peak operation.

Planning for Energy Audit?

Contact US Now –

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