Industrial Assessment Center

University of Illinois at Chicago

The UIC-IAC

- A division of the Energy Resources Center (ERC), UIC's energy consulting arm
- ERC established in 1973 as a "fast response" team of energy experts capable of quickly extending
  - Technical expertise
  - Advice
  - Professional assistance
- Since establishment in 2000, the UIC-IAC draws upon ERC faculty and staff to lead assessments, as well as works with other ERC units to leverage expertise

mjc2

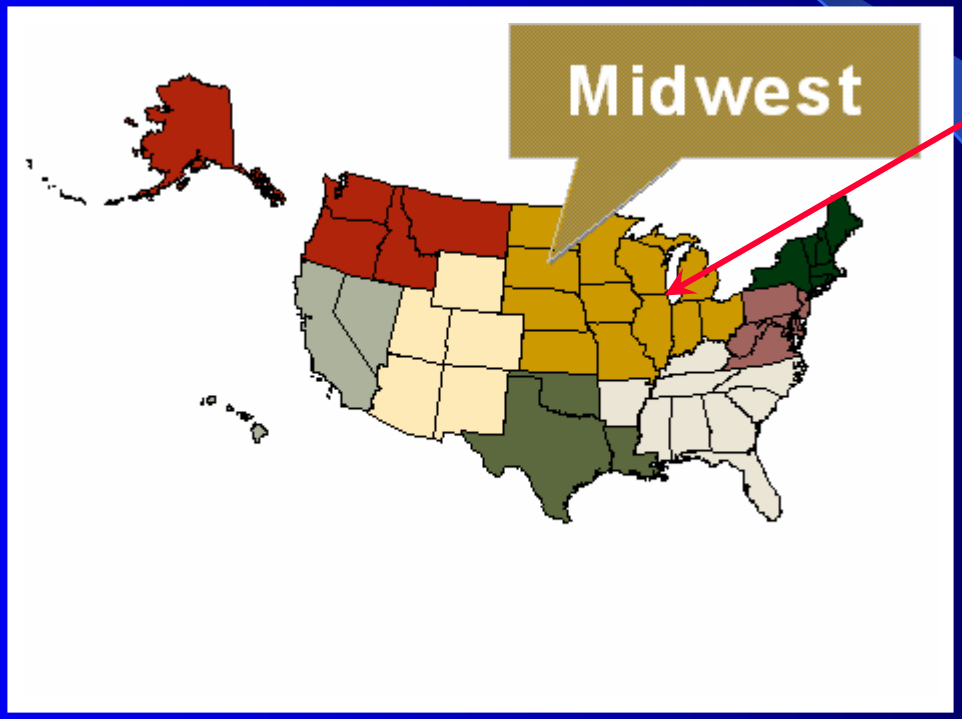
mjc2 What is the source of the implementation rate number?
mchimack, 4/29/2003

MIDWEST CHP APPLICATION CENTER

Regional Cooling, Heating and Power Application Center

IAC UIC

Midwest Regional Application Center (MAC or RAC)



What is CHP?

- Combined heat and power
- Integrated system
- Located at or near a plant
- Provides a portion (or all) of the electrical load
- Utilizes the thermal energy for
  - Cooling
  - Heating
  - Dehumidification
  - Process heat

Midwest CHP Application Center

- Develop technology application knowledge and the educational infrastructure necessary to
  - Reduce perceived risks
  - Foster CHP as a viable option
    - Technical and financial
    - Energy and environmental
- Focus
  - CHP analysis
  - Technology transfer
  - Education
  - Information
  - Project assistance

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IAC/MAC Crosscutting

IAC provides

- First cut screen for applicability for CHP
- Source for potential CHP application sites
- Conduit for information transfer to industrial users

MAC provides

- Training on screening techniques for potential CHP sites
- Tools necessary to consider/evaluate CHP as one of the auditor's energy efficiency options
- Backup and/or follow-up technical and and analysis support for audit customers
- CHP information/case studies through CHP website

A Working Relationship

Close Affiliation

- Assistance from former IAC student
- Friendly and familiar neighbors

Comprehensive Training

- IAC students attend MAC sponsored training
- UIC courses offered by MAC facility members
- Onsite CHP training

International Truck and Engine Corporation
Energy Assessment

Dr. William M. Worek, Director
Michael J. Chimack, Assistant Director
Arturo Hernandez, Lead Student
Brian Malone, Lead Student
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International Truck and Engine Corporation
Energy Assessment

Summary of Results

International Truck Assessment

- Conducted by UIC-IAC in June 2005
- Identified 7 assessment recommendations (ARs) totaling $850,326/yr in savings with a payback of 4.6 years

Summary of Recommendations

AR No.	Description	Cost Savings ($/yr)	Resource Conserved	Implementation Cost ($)	Simple Payback
1	Update Cogeneration Operation Tool	$25,000	None	$0	Immediate
2	Optimize Cogeneration Equipment	$437,212	Natural Gas, Electricity	$3,259,200	7.5 years
3	Replace Steam to Hot Water Heat Exchangers With a Hot Water Boiler	$294,938	Natural Gas	$501,372	1.7 years
4	Install Economizer on Boiler #3	$17,632	Natural Gas	$22,464	1.3 years
5	Repair Steam Leaks	$1,239	Natural Gas	$400	4 months
6	Insulate Condensate Return Piping	$37,809	Natural Gas	$131,160	3.5 years
7	Repair Compressed Air Leaks	$36,496	Electricity	$2,100	1 month
Total		**$850,326**	**---**	**$3,916,696**	**4.6 years**

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International Truck Energy Summary

	Baseline Energy Usage	Energy Usage After Implementation	Reduction	Reduction (%)
Electric Energy (kWh)	52,223,527	49,759,987	2,463,540	5%
Natural Gas (MMBtu)	413,720	338,766	74,954	18%
Total Utility Costs ($/yr)	$5,770,980	$4,920,654	$850,326	15%

AR #3: Replace Steam to Hot Water Heat Exchangers with a Hot Water Boiler

- Replace the steam to hot water heat exchangers with a hot water boiler to increase the system efficiency and reduce the amount of natural gas used to make steam.

Natural Gas Cost Savings	$294,938
TOTAL Annual Savings	$294,938
Implementation Cost	$501,372
Simple Payback	1.7 years

AR #4: Install Economizer on Boiler #3

- Install an economizer on the stack of Boiler #3 to recover waste heat. An economizer can be used to preheat the boiler feedwater, which would result in reduced boiler energy usage.

Natural Gas Cost Savings	$17,632
TOTAL Annual Savings	$17,632
Implementation Cost	$22,464
Simple Payback	1.3 years

AR #5: Repair Steam Leaks

- It is recommended that the two steam leaks found during the assessment be repaired. Fixing the steam leaks would reduce the steam requirements on the boiler, resulting in natural gas savings.

Natural Gas Cost Savings	$1,138
Water Cost Savings	$101
TOTAL Annual Savings	$1,239
Implementation Cost	$400
Simple Payback	4 months

AR #6: Insulate Condensate Return Piping

- Insulate condensate return piping in order to achieve a higher condensate return temperature. Returning condensate at a higher temperature would reduce water and natural gas consumption of the boiler system, thereby decreasing boiler operating costs.

Natural Gas Cost Savings	$37,769
Water Cost Savings	$40
TOTAL Annual Savings	$37,809
Implementation Cost	$131,160
Simple Payback	3.5 years

AR #7: Repair Compressed Air Leaks

- Repair the compressed air leaks found during the assessment. By doing so, the load on the air compressors would be reduced, resulting in electrical energy savings.

Electrical Energy Cost Savings	$36,496
TOTAL Annual Savings	$36,496
Implementation Cost	$2,100
Simple Payback	1 month

International Truck and Engine Corporation
Energy Assessment

CHP Analysis

Cogeneration System

- 12 Caterpillar reciprocating engines
- 6 HRSGs (1,200 lbs/hr ea; 7,200 lbs/hr total)
  - Supplies base summer load
  - Boilers fire during winter
- 1.6 MW backup diesel generator
- Hourly energy pricing (HEP)

Other Energy Equipment

- 3 oversized boilers (30 psig steam)
  - 5,000 lbs/hr-18,000 lbs/hr seasonal steam load
  - 2/3 of load for space heating
  - Domestic hot water
  - Very little process steam usage

Other Energy Equipment

- Decentralized chilled water supply
  - 500 tons total, 1,300 gpm (44°F-54°F)
  - Engineering Department (200 tons)
  - VAV system (300 tons)
  - There are additional chillers in engineering operating at supply temperatures below 40°F

Current System Operation

- Currently uses two MS Excel spreadsheets to determine the operation of the system
- Calculates the break even point for generating on a monthly basis
  - Corresponds to varying natural gas price each month
- Calculates daily purchasing cost and compares it to break even cost

AR #1: Upgrade Cogeneration Operation Tool

- Upgrade the modeling tool used to determine the operation of the cogeneration system
  - Centralizes data to one spreadsheet
  - Allows for updates and correction of variables
  - Increases knowledge of the cogeneration operation
  - Efficiently tracks savings from the system and relation to operating cost
  - Increases accuracy for better decision making

System Operation Comparison

- Current Modeling Tool
  - General data is updated monthly
  - Calculates break even cost for evaluation
  - Only calculates partial generation savings
- New Modeling Tool
  - More accurate data and enables better decision making
  - Allows for daily updated information
  - Calculates and compares generating and purchasing costs daily
  - Changes to the cogeneration system can be addressed more easily

AR #2: Optimize Cogeneration Equipment

- Increase Heat Recovery
- Remove Some Steam Space Heating to Allow Complete Steam Generation with HRSGs
- Install a Central Chilled Water Plant with Absorption Chilling

Increase Heat Recovery

- Install additional Heat Recovery Steam Generators (HRSGs) and Absorption Chiller
  - Recover heat from all of the engines
  - Save natural gas from boiler system
  - Decrease electrical load while operating Cogen

TOTAL Annual Savings	$34,540 *
Increased Cogeneration System Operation Time	17%

* Based on 2004-2005 operating costs

Remove a Portion of the Steam Space Heating System to Allow Complete Steam Generation with HRSGs

- Remove Some Steam Space Heating
  - Removing steam heating for direct space heating creates energy savings on its own, but is not practical to remove steam heat for the entire plant
  - Shed enough steam (3,300 lb/hr) to completely operate off of the cogeneration steam in the winter (w/ 12 HRSGs) for maximum heat recovery savings from the cogeneration system
  - (How does the plant get by with reduced heat level?)

    - TOTAL Annual Savings $116,988 *

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* Based on 17% increase of cogeneration hours w/ additional heat recovery

Install a Central Chilled Water Plant with Absorption Chilling

- Install a chilled water plant
  - Allows for the installation of absorption chilling
  - Create electrical savings when cogeneration system is not running
  - Allows for an increase chilled water capacity
  - Improve chilled water maintainability

Electrical Energy Cost Savings	$91,608 *
Demand Cost Savings	$205,140 **
Increased O&M Costs	($11,064)
TOTAL Annual Savings	$285,684

* Based on 17% increase of cogeneration hours w/ additional heat recovery

** Based on a reduced utility cost created by manipulating the max demand (only possible by adding large electric equipment like these chillers)

Total Savings & Implementation

- Total Annual Savings $437,212/yr
- Total Implementation Cost $3,259,200
- Simple Payback 7.5 years

Total Savings & Implementation Cost

Description	Size	Cost per Unit ($)	Quantity ($)	Total Cost ($)
HRSGs	1200 lb/hr	$60,000	6	$360,000
Direct-Fire Unit Heaters	---	$2,100	15	$31,500
Electric Chillers	800 ton	$155,000	4	$620,000
Absorption Chiller	662 ton	$500,000	1	$500,000
Chilled Water Piping	---	$1,204,500	1	$1,204,500
Contingency	---	20%	1	$543,200
Total	**---**	**---**	**28**	**$3,259,200**

UIC-IAC Leveraging the MAC

- Advantages of the dual approach
  - IAC - Allowed a more in-depth analysis of the entire cogeneration system
  - MAC – Gained a better understanding of the systems driving the steam load
- Provided the facility a new tool to in order to calculate the economics of the cogeneration system
- UIC-IAC had the personnel and knowledge to improve the quality of the cogeneration recommendations

IACs Should Leverage the RACs

- Regional Application Centers
- Contact them and get their screening tool
- Incorporate CHP screening, if not CHP recommendations, into reports
- Good for the IAC program, the CHP RACs, and the manufacturers

RAC Contact Information

REGION	STATES	KEY CONTACTS
Intermountain CHP RAC	Arizona, Colorado, New Mexico, Utah, and Wyoming	Patti Case 801-278-1927 plcase@etcgrp.com
Mid-Atlantic CHP RAC	Delaware, Maryland, New Jersey, Pennsylvania, and Virginia	Dennis Moran, University of Maryland 301-405-4681 dmoran@umd.edu
Midwest CHP RAC	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin	John Cuttica, UIC Energy Resources Center 312-996-4382 cuttica@uic.edu
Northeast CHP RAC	Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont	Larry Ambs, UMass Amherst 413-545-2539 ambs@ceere.org Tom Bourgeois, Pace University Energy Project 914-422-4227 tbourgeois@law.pace.edu
Northwest CHP RAC	Alaska, Idaho, Montana, Oregon, and Washington.	David Sjoding, Washington State University 360-956-2004 sjodingd@energy.wsu.edu
Pacific CHP RAC	California, Hawaii, Nevada, and the Pacific Territories	Tim Lipman, University of California, Berkeley 510-642-4501 telipman@berkeley.edu
Gulf Coast CHP RAC	Texas, Louisiana, and Oklahoma.	Daniel Bullock, Houston Advanced Research Center 281-364-6087 dbullock@harc.edu
Southeastern CHP RAC	Alabama, Arkansas, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee.	Louay Chamra, Mississippi State University 662-325-0618 chamra@me.msstate.edu Alex Hobbs, NC State University 919-515-6366 aohobbs@ncsu.edu

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