Final Technical Report

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SPONSORING DOE PROGRAM OFFICE - USDOE - Office of Energy Efficiency and Renewable Energy (EE)
SUBJECT CATEGORIES: ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION
KEYWORDS: Energy Assessments; Energy Conservation

Executive Summary

Provide a brief executive summary which includes a discussion of 1) a summary of the center's accomplishments; 2) how the effort contributed to energy savings in the U.S.; and 3) how the project is otherwise of benefit to the public. Note: This section can be cut and pasted into the online DOE Form 241.3 in the Description/Abstract section.

Since its establishment in 1990, San Diego State University's (SDSU) Industrial Assessment Center (IAC) has served close to 400 small and medium-sized manufacturing plants in Southern California. SDSU/IAC's efforts to transfer state-of-the-art technologies to industry have increased revenues, cultivated creativity, improved efficiencies, and benefited the environment. In addition to financial savings and environmental benefits, we believe that many of our productivity improvement recommendations have also proven to be worker-friendly. A substantial benefit from the proposed program has been the ongoing training of engineering faculty and students. Just during this funding cycle, SDSU/IAC has also trained 31 students, 7 of them graduate. All of these students were offered jobs within weeks of their graduation. The activities of the SDSU/IAC have expanded the institutional expertise of the College and improved the knowledge base of the faculties involved leading to several related publications, master's theses, and senior student projects. Significant number of peer-reviewed

publications of the IAC director at SDSU have greatly benefitted from the experience of the Center. As a result of this extensive exposure to manufacturing processes, the SDSU/IAC has grown to be an integral component of SDSU's engineering research and training curriculum. We have successfully built upon these established achievements, tradition of quality service, and academic excellence. IAC's service to industry is particularly vital in Southern California, a region with one of the highest manufacturing concentrations in the country. SDSU/IAC has understood and implemented the overall objectives of DOE's IAC program and guidelines.

The IAC has increased student awareness of existing energy efficiency practices, typical industrial waste streams, modern manufacturing technologies, associated regulatory issues, and related tools of software. In addition, the Center has helped state and local governments as well as utility companies to assess or consider offering rebates and incentives. The Center has contributed to the region's economic growth and stability by assisting companies to better compete in the global industrial market. It has helped mitigate climate change by reducing greenhouse gas emissions and hazardous waste streams. IAC activities have fostered productive relationships between the University and local industry, assist industrial sectors to improve their energy efficiency, reduce waste, and enhance their manufacturing productivity, in turn impacting the material and working conditions of their employees.

Task Summary

Summarize the IAC's activities by task for the entire period of funding.

Task 1: Conduct Industrial Assessments, to include a variety of plant types and sizes and well as coverage of the geographic area defined in the Annual Workplan Industrial Assessments: *Provide a summary of the assessments performed over the life of the award. Include overall number of assessments, types of businesses assessed, number of ARs, and any other related info.*

The following table lists the total **assessment days and submitted reports** during the funding cycle:

Year	Assessments	Assessment Days
2002-2003	22	25
2003-2004	24	27
2004-2005	20	23
2005-2006	16	20
2006-2007	10	13
Total	**92**	**108**

ID	VISITDATE	SIC	NAICS	# AR
SD0399	2007-08-22	3281	327991	5
SD0398	2007-08-15	3724	332322	5
SD0397	2007-07-06	3324	331512	9
SD0396	2007-04-19	3089	326199	5
SD0395	2007-03-22	3089	326199	6
SD0394	2007-02-22	3491	332911	5
SD0393	2007-02-15	2992	324191	4
SD0392	2006-11-30	3751	336991	4
SD0391	2006-10-12	3999	325998	5
SD0388	2006-08-24	2051	311812	6

SD0390	2006-08-22	2051	311812	8
SD0389	2006-08-17	2033	311421	5
SD0387	2006-07-10	3841	339112	5
SD0386	2006-07-06	2899	325998	4
SD0385	2006-05-02	2053	311813	5
SD0384	2006-04-13	1422	212312	6
SD0383	2006-04-06	3463	332112	-
SD0382	2006-03-23	3269	324122	5
SD0381	2006-03-14	3089	326199	6
SD0380	2006-02-02	2591	337920	5
SD0379	2005-12-15	3593	333995	6
SD0378	2005-11-10	8731	541710	7
SD0377	2005-11-01	3841	339112	8
SD0376	2005-10-13	3053	339991	7
SD0375	2005-09-08	3463	332112	8
SD0374	2005-08-17	2599	337127	7
SD0373	2005-08-11	2052	311821	9
SD0372	2005-07-14	3541	333512	9
SD0371	2005-06-17	3089	326199	8
SD0370	2005-05-16	3315	331111	7
SD0368	2005-04-21	2062	311312	11
SD0369	2005-04-19	3569	332913	8
SD0367	2005-03-24	3432	332913	10
SD0365	2005-03-15	3251	327121	10
SD0366	2005-03-08	3089	326199	11
SD0364	2005-02-10	3262	326200	5
SD0363	2005-02-08	3315	332611	10
SD0362	2005-01-18	3315	332611	7
SD0361	2005-01-11	3088	326191	5
SD0360	2005-01-06	3211	267720	6
SD0359	2004-12-21	3544	426445	10
SD0358	2004-12-02	3088	326191	8
SD0357	2004-11-18	3088	326191	6
SD0356	2004-10-21	2653	322211	7
SD0355	2004-09-13	3829	334519	7
SD0354	2004-08-05	3411	332812	5
SD0353	2004-08-04	3089	326199	7
SD0352	2004-07-12	3089	326199	9
SD0351	2004-07-01	3251	327121	7
SD0350	2004-06-24	3053	339991	5
SD0349	2004-05-27	3452	332722	6
SD0348	2004-05-25	3089	326199	7
SD0347	2004-05-06	2673	326111	5
SD0346	2004-04-29	3081	425678	5
SD0345	2004-04-15	3081	425678	7
SD0344	2004-04-08	3493	332611	5
SD0343	2004-04-01	2844	325620	8
SD0342	2004-03-25	3452	332722	13
SD0341	2004-02-12	3824	334514	5

SD0332	2004-02-12	2653	322211	6
SD0340	2004-01-22	3679	334419	5
SD0339	2004-01-15	3841	339112	5
SD0338	2003-12-18	2711	511110	6
SD0337	2003-12-17	2711	511110	5
SD0336	2003-12-11	2092	311712	5
SD0335	2003-12-04	3599	335212	9
SD0333	2003-11-06	3069	326299	8
SD0334	2003-10-20	2469	332116	5
SD0331	2003-10-03	2672	322222	5
SD0330	2003-05-28	3452	332722	6
SD0329	2003-05-19	2747	511140	5
SD0328	2003-05-15	2051	311812	8
SD0327	2003-04-10	2097	312113	5
SD0326	2003-03-27	3443	332312	8
SD0325	2003-03-20	3841	339112	8
SD0324	2003-03-06	3061	326291	7
SD0323	2003-02-27	3089	326199	9
SD0322	2003-02-20	3441	332312	9
SD0321	2003-02-13	3053	339991	7
SD0319	2003-02-13	3061	326291	10
SD0320	2003-01-30	3444	324122	19
SD0317	2002-12-13	3259	327123	7
SD0318	2002-12-12	3053	339991	7
SD0316	2002-11-21	2037	311411	7
SD0315	2002-11-14	3053	339991	12
SD0314	2002-10-31	3851	339115	12
SD0313	2002-10-17	3354	331316	8
SD0312	2002-10-10	3732	336612	5
SD0311	2002-10-03	3825	334513	5
SD0310	2002-09-26	3354	331316	11
SD0309	2002-09-19	2086	312111	10
			Total ARs	638

As can be seen from the above table, our audits covered wide range of SICs in all the Counties of Southern California: Los Angeles, Orange, Riverside, San Bernardino, and San Diego.

TASK 2: Promote and increase the adoption of assessment recommendations *(Please describe/highlight all activities done during Quarter that support/fulfill the requirements of this task, as described in the Annual Workplan.* ***In particular, please detail any specific activities undertaken to improve implementation and discuss the effectiveness of such efforts. Also, please complete the table below regarding 12-month follow-up with selected clients, which is a required element of each year's workplan.)***

We have established a working strategy to interact with plant managers of sites we have audited. To promote implementation, when requested, we offered further research or input for specific recommendations. During our visit (after a brief tour of the plant), we submitted our preliminary Assessment Recommendations (AR). Feasibility discussions engage the interest of plant managers and

other policy makers present. This approach helped us determine which ARs would potentially be implemented. During our exit interviews with plant managers and other personnel, we regularly summarized our recommendations with detailed information on the potential savings of these recommendations. In addition, we have introduced to our report a session on major state incentives that may encourage implementation of the recommendations.

Implementation reports were tailored to the client's facility. CogenPro (our own software to size and select CHPs) recommendations are vital to our Assessment Recommendations. Within a month from mailing out a report, we often sent a follow up letter requesting them to implement our recommendations. One team member persistently calls after 6 months until the recipient of the report comments on each AR. We believe that our detailed and informative reports along with our persuasive approaches are effective in boosting up the level of implemented recommendations.

TASK 3: Promote the IAC Program and enhance recruitment efforts for new clients and expanded geographic coverage *(Please describe/highlight all activities done during Quarter that support/fulfill the requirements of this task, as described in the Annual Workplan)*

We have covered all the counties within Southern California. Our geographic area is primarily within Los Angeles Department of Water and Power, Southern California Edison, and San Diego Gas & Electric utilities. We attend workshops hosted by these utility companies which allow us to be in contact as well as assure them we are keeping up to date on the latest energy efficiency technology. Such cooperation has helped us identify manufacturing plants in our district for audits and receive recommendations for potential clients. We have used Harris database extensively for client database.

TASK 4: Provide educational opportunities, training, and other related activities for IAC students *(Please describe/highlight all activities done that support/fulfill the requirements of this task, as described in the Workplan)*

All our IAC graduates were employed with ease, many offered higher benefits and salaries than other graduates. We continue maintaining a fair mix of undergraduate and graduate students. All students are being trained to use all our audit equipment such as thermometers, power meters, combustion analyzer, air leak detector, voltage meters, humidity sensor, Fluke multimeter/oscilloscope, light meter and other relevant equipment. In addition, they are being trained in the best practices software tools.

The immense knowledge and experience students get from audits helps them contribute significantly to the economy of employers as soon as they get hired. So far, all our students get employed as soon as they graduate. Hence, the IAC remains as a solid training institute with great benefits to both the plants, who obtain a free energy audit, and students who accumulate excellent experience from conducting and writing audit reports.

37 Students trained.

Relevant peer-reviewed publications in which IAC experience was used directly or indirectly during this funding cycle:

1. Moman A., Beyene, A., Exergy Analysis of Energypark, International Exergy, Energy and Environment Symposium, Evora, Portugal, July 1-5, 2007

2. Beyene A., Moman A., Process Oriented Industrial Energy Intensity Classification, Applied Thermal Engineering, Vol. 26, 2079-2086, 2006

3. Beyene, A., Lambert M., Sizing Oxidation Systems as Heat and Power Recovery, International Journal of Energy Research, Vol. 30, p. 823-834, 2006

4. Beyene A. and Moman A., Process Oriented Matching and System Optimization of Energyparks, 19th International Conference on Efficiency, Cost, Optimization, Simulation and Environmental Impact of Energy Systems, Capsis Hotel, Aghia Pelagia, Crete, Greece, 12-14 July 2006

5. Beyene A., Combined Heat and Power as a Feature of Energypark, ASCE Journal of Energy Engineering, Vol. 131:3, p.173, December 2005, lead article

6. Beyene A., Energy Efficiency and Industrial Classification, Energy Engineering Journal, pp. 59-80, Vol. 102, No.2, 2005

7. Beyene A., Sizing Industrial CHP for Maximum efficiency, Journal of Cogeneration and on-site Power Production, pp 45-49, Vol. 4, #1, 2003

8. Beyene A., Erpelding, B., "Smart" Simulation of CHP systems, World Energy Engineering Congress, Atlanta, November, 2003

9. Erpelding B., Beyene A., A comprehensive combined Heat and Power Sizing Software, 16th International Conference on Efficiency, Costs, Optimization, Simulation and Environmental Impact of Energy and Process Systems, Copenhagen, Denmark, July 2003

10. Beyene A., Sizing combined heat and power as waste heat recovery, ASME TURBO EXPO Atlanta, June, 2003

11. Luz-Silveira J., Beyene A., Leal E., Santana J., Okada D., Thermoeconomic Analysis of a Cogeneration System, Journal of Applied Thermal Engineering, vol. 22, pp 1471-1483, 2002

12. Beyene A., Potentials and challenges of Industrial Energy Efficiency in Southern California, 15th International Conference on Efficiency, Costs, Optimization, Simulation, and Environmental Impact of Energy Systems, Berlin, Germany, pp 1286-1293, July 3-5, 2002

13. Beyene A., Combined Heat and Power Sizing Methodology, ASME Turbo Expo 2002, Industrial and Cogeneration, June 3-6, Amsterdam, The Netherlands, GT-2002-30567, 2002

TASK 5: Coordinate and integrate Center activities with other Center and IAC Program activities, DOE's Industrial Technologies programs and others. *(Please describe/highlight*

all activities done during Quarter that support/fulfill the requirements of this task, as described in the Annual Workplan)

The program has proven very useful both to the audited plants and the students. The positive reaction of plant managers during our closing meetings indicates the benefits they gain out of such a service. Consequently, many plants ultimately hire our graduates and many still ask us if we have students that are about to graduate.

In addition to incentives and important non-profit contact addresses, we included a Best Practices section in our reports. We also continue our leadership role in CHP area – CogenPro is used regularly by at least a few other Centers.

Other Funding sources in which IAC experience was directly or indirectly useful:

- Process oriented energy intensity classification for demand response, SDG&E, 2006
- South West Combined Heat and Power Application, DOE through California Energy Commission

Task 6: Other tasks or special projects, as needed, and as determined by DOE to be advantageous to the program and in furtherance of IAC Program goals. *Briefly describe any other special projects or tasks performed for DOE under the award.*