Appendix 4:
Method of Calculating Results for the IAC Program

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The Industrial Assessment Centers (IAC) within the Industrial Technologies Program (ITP) have been successfully generating energy savings for over 30 years. Twenty-six IACs located within engineering departments at top universities across the U.S. conduct energy assessments for small- and medium-sized manufacturers and train the future workforce of energy engineers.

The following table presents energy savings calculated and summed from four sources associated with the IAC program from 1977-2009: (1) IAC energy assessments, (2) assessments performed by IAC student alumni, (3) replication assessments within firms served by the IAC, and (4) IAC website-related energy savings. Output and savings estimates rely on information from the IAC assessment database (administered by Rutgers University), the IAC student registry, and evaluations conducted by Oak Ridge National Laboratory (ORNL). The IAC database documents savings recommendations and implementation history for plant assessments conducted over a 28-year period, covering more than 14,800 assessments and nearly 110,000 savings recommendations. The IAC student registry, established in 2001, tracks the progress of students from their starting date until their departure from the IAC. Finally, ORNL evaluations have studied the longer-term effects of plant assessments, career paths of IAC alumni, and the savings potential of web-based materials offered by the IAC.

Tabulations shown in the table are based on data collected by the IACs and studies done to estimate the nonassessment benefits. The first two rows of the table show the number of assessments conducted each year and the savings associated with each new assessment. The savings from each assessment are assumed to persist for seven years. Therefore, the energy saved in each year (shown in row three) is the sum of energy savings from new assessment savings for that year plus the savings from measures implemented in the previous six years that continue to persist.

The contribution of assessments (or other, equivalent professional services) performed by IAC student alumni is estimated based on averaged student registry data and feedback from IAC alumni who are practicing energy engineers. In 2009, 115 fully trained students graduated from the IAC, and cumulatively over 2,955 IAC students graduated. According to ORNL research and alumni feedback, about 50% of the alumni have remained in the energy-efficiency business and each alumnus performs the equivalent of 4 assessments per year for 11 years after leaving the IAC program. The benefits of each energy assessment (or equivalent intervention) were assumed to persist for seven years, after which the aged energy assessment was "retired" for the purposes of this estimation. The annual energy savings from alumni assessments are shown in row four in the table.

The savings from replications from assessment activities are calculated as 25% of the energy saved in the prior year from all assessment activities. This calculation accounts for the ancillary effect of additional implementations that are initiated later but are the result of the IAC's influence. These implementations may be accomplished at the same plant as the original implementations, or at other plants within the same company, or within other plants at other companies as plant managers/engineers/workers change jobs but take the energy efficiency know-how with them. The annual energy savings from replication activities are shown in row five in the table.

The IAC website maintained at Rutgers University was estimated to begin having an impact on energy savings in 1998. The methodology for determining the savings from web users relies on server data, IAC assessment savings, and data from the literature to approximate energy savings associated with the on-line, user-friendly version of the IAC database. While most centers host IAC-related websites, several of which contain useful software tools and publications developed by students and faculty, IAC savings estimates focus solely on the on-line version of the IAC database. The output estimate for the IAC website is based on the number of unique plants that used the on-line database. Server reports from Rutgers have identified about 24,540 annual visitors to the website, 6,050 of which were likely to represent unique U.S. plants. According to software use experience for similar programs, only 11% of those accessing the IAC database likely use it and only 14% of this number implement energy saving projects with the information provided. The estimates of energy savings are based on the savings generated by the unique plants that use the on-line database each year to implement energy-saving projects. Each unique plant that implements a project is assumed to save the equivalent of a single IAC assessment, or 7,040 MMBtu in 2009. As with the other assessments, energy savings are assumed to persist for seven years.

The annual and cumulative energy savings from all IAC activities are shown in the table for each year. In 2009, the annual energy savings are 245 TBtu and the cumulative energy savings through 2009 are 2,202 TBtu. Energy cost savings, carbon reduction, and other benefits are related to energy savings by projected fuel prices and emission coefficients. The cumulative energy cost savings and the cumulative carbon reduction are shown for the IAC program through 2009 in the last two rows of the table.

IMPACTS

Item	1977	1978	1979	1980	1981	1982	1983	1984
Number of Assessments	82	70	636	224	359	253	211	248
Annual Energy Saved Per New Assessment (*MBtu/Assessment-Year*)	3,212	3,212	3,212	3,212	3,212	1,782	2,047	3,504
Energy Saved From Assessments (*TBtu*)	0.263	0.488	2.53	3.39	5.01	5.65	6.41	7.11
Energy Saved From Alumni Assessments (*TBtu*)	–	–	0.09	0.27	0.57	0.84	1.26	2.27
Replication Energy Savings (*TBtu*)	0.0	0.065	0.125	0.52	0.24	0.37	0.16	0.19
Annual Energy Savings (*TBtu*)	0.263	0.553	2.74	4.18	5.82	6.86	7.82	9.57
Cumulative Energy Savings (*TBtu*)	0.263	0.816	3.56	7.74	13.6	20.4	28.2	37.8
Energy Cost Savings (*B$*)	0.001	0.002	0.009	0.024	0.050	0.085	0.125	0.173
Carbon Reduction (*MMTCE*)	0.005	0.015	0.066	0.143	0.250	0.376	0.519	0.695

Item	1985	1986	1987	1988	1989	1990	1991	1992
Number of Assessments	368	298	324	388	340	360	455	531
Annual Energy Saved Per New Assessment (*MBtu/Assessment-Year*)	4,208	4,520	3,898	3,842	4,724	3,821	3,207	3,942
Energy Saved From Assessments (*TBtu*)	8.49	7.92	8.40	8.87	10.0	11.2	12.2	12.8
Energy Saved From Alumni Assessments (*TBtu*)	3.96	6.27	8.79	11.8	16.0	19.9	23.3	27.1
Replication Energy Savings (*TBtu*)	0.44	0.80	0.84	0.88	1.09	1.39	1.19	1.26
Annual Energy Savings (*TBtu*)	12.9	15.0	18.0	21.5	27.1	32.5	36.7	41.2
Cumulative Energy Savings (*TBtu*)	50.7	65.7	83.7	105	132	165	202	243
Energy Cost Savings (*B$*)	0.238	0.303	0.379	0.468	0.587	0.736	0.899	1.09
Carbon Reduction (*MMTCE*)	0.932	1.21	1.54	1.93	2.43	3.02	3.68	4.43

Item	1993	1994	1995	1996	1997	1998	1999	2000
Number of Assessments	585	776	879	867	720	723	755	705
Annual Energy Saved Per New Assessment (*MBtu/Assessment-Year*)	3,314	3,074	2,978	3,002	2,500	2,185	2,856	2,408
Energy Saved From Assessments (*TBtu*)	13.4	14.6	16.0	17.1	17.8	18.2	18.4	18.1
Energy Saved From Alumni Assessments (*TBtu*)	30.0	33.3	36.4	38.9	41.0	43.2	45.9	47.7
Replication Energy Savings (*TBtu*)	1.70	1.54	1.84	2.04	2.17	1.84	1.66	2.25
Web Users Energy Savings (*TBtu*)	–	–	–	–	–	0.04	0.12	0.20
Annual Energy Savings (*TBtu*)	45.1	49.6	54.2	58.1	61.0	63.3	66.1	68.3
Cumulative Energy Savings (*TBtu*)	288	337	392	450	511	574	640	709
Energy Cost Savings (*B$*)	1.29	1.51	1.74	2.02	2.31	2.58	2.89	3.28
Carbon Reduction (*MMTCE*)	5.24	6.13	7.10	8.14	9.24	10.4	11.6	12.8

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Item	2001	2002	2003	2004	2005	2006	2007	2008
Number of Assessments	639	649	620	635	555	450	385	403
Annual Energy Saved Per New Assessment (*MBtu/Assessment-Year*)	3,935	6,800	6,620	7,140	7,070	9,540	8,182	7,809
Energy Saved From Assessments (*TBtu*)	18.2	19.9	21.3	24.5	27.4	30.3	32.3	33.5
Energy Saved From Alumni Assessments (*TBtu*)	54.3	69.4	85.1	106	127	155	178	198
Replication Energy Savings (*TBtu*)	1.97	3.33	6.14	6.05	6.78	6.65	8.68	7.23
Web Users Energy Savings (*TBtu*)	0.38	0.79	1.29	1.91	2.76	3.98	4.65	5.00
Annual Energy Savings (*TBtu*)	74.9	93.4	114	139	164	196	224	243
Cumulative Energy Savings (*TBtu*)	783	877	991	1,129	1,294	1,490	1,714	1,957
Energy Cost Savings (*B$*)	3.72	4.22	4.95	5.97	7.42	9.25	11.4	14.3
Carbon Reduction (*MMTCE*)	14.1	15.8	17.9	20.4	23.3	26.9	30.9	35.3

Item	2009	2010	2011	2012	2013	2014	2015	2016
Number of Assessments	325							
Annual Energy Saved Per New Assessment (*MBtu/Assessment-Year*)	7,040							
Energy Saved From Assessments (*TBtu*)	31.6							
Energy Saved From Alumni Assessments (*TBtu*)	202							
Replication Energy Savings (*TBtu*)	6.76							
Web Users Energy Savings (*TBtu*)	5.15							
Annual Energy Savings (*TBtu*)	246							
Cumulative Energy Savings (*TBtu*)	2,203							
Energy Cost Savings (*B$*)	16.4							
Carbon Reduction (*MMTCE*)	39.7							