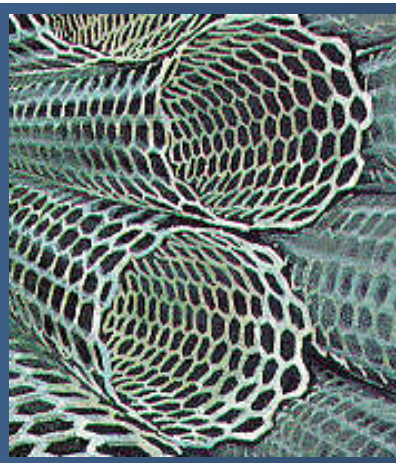
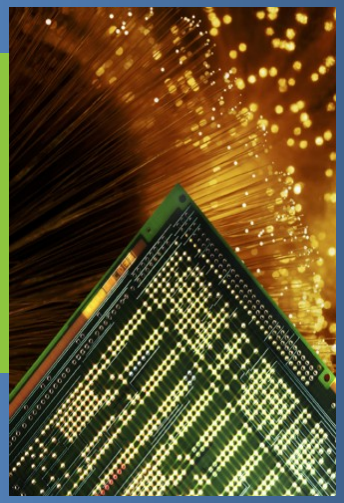
U.S. Department of Energy
Energy Efficiency and Renewable Energy
Bringing you a prosperous future where energy is clean, abundant, reliable, and affordable

Save ENERGY Now

Targeted Savings in the Industrial Sector: Results from DOE's Save Energy Now Initiative

Tony Wright
Michaela Martin
Sachin Nimbalkar
Oak Ridge National Laboratory

Presented at
CEE Program Meeting
June 11-12, 2008

The U.S. Department of Energy is delivering technology solutions

Partnerships

Collaborative R&D

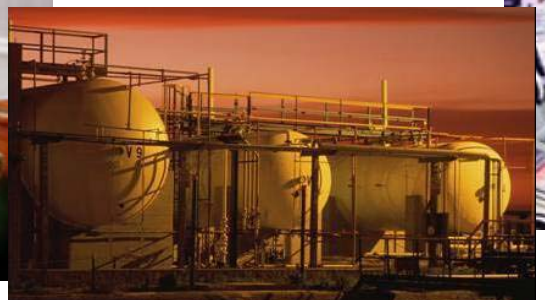
- Energy-Intensive Process Technologies
- Crosscutting Technologies

Technology Delivery

- Energy Savings Assessments
- Industrial Assessment Centers
- Training and Tools
- Publications and Information

The program encompasses four primary technology delivery channels

- **Save Energy Now Assessments**
  Energy experts work with plant personnel to identify the best opportunities for energy savings at large industrial facilities
- **Industrial Assessment Centers**
  No-cost assessments provided to eligible small & mid-size plants by university-based teams
- **Tools and Training**
  Training in best practices and software tools to improve plant energy performance
- **Publications/Information**
  Websites, newsletters, webcasts, case studies, tip sheets, technical briefs, clearinghouse, allied partners, showcases, energy events, etc.



Why focus on energy assessments?
Pressing energy supply and cost issues

"Our Energy Saving Teams will work with on-site managers on ways to conserve energy and use it more efficiently."

Secretary Bodman at the Caterpillar Tractor Assessment

U.S. Department of Energy
Secretary Bodman
National Press Club
October 3, 2005

Give a man a fish and he will eat for a day.

Teach a man to fish and he will eat for a lifetime.

The Save Energy Now Assessment process is well structured

Gather Preliminary Data → **Conduct Plant Visit** → **Analyze & Report Results** → **Follow-up**

→ **Train Plant Staff** →

- Teams are DOE Energy Experts and plant personnel
- Teams focus on fans, pumps, compressors, steam or process heating systems
- Plant personnel are trained on DOE software tools

SAVE ENERGY NOW – Updated Results

- In calendar year 2006, focus was on process heating and steam, with 200 assessments completed
- In 2007, expanded to include all system types, with 258 assessments completed
- Total 458 Save Energy Now Assessments performed during 2006 – 2007
- 434 assessments with final summary reports
- 305 assessments with follow-up information

SUMMARY OF IDENTIFIED SAVINGS
(434 Assessments)

Total identified source energy savings = 90.1 TBtu per year

Total identified energy cost savings = $740 million per year

Total 434 Assessments (ESAs with summary report)

The amount used annually by 1 million single family homes*

Total identified CO_2 reduction = 6.36 million MTons per year

Equivalent to taking 1 million cars off the road¥

Total identified natural gas savings 72.8 TBtu per year

* EIA Data

¥ EPA calculator

SUMMARY OF IMPLEMENTED SAVINGS
(305 Assessments)

Source energy:
Implemented: 20.2 TBtu/year
In-Progress: 13.8 TBtu/year
In-Planning: 16.2 TBtu/year

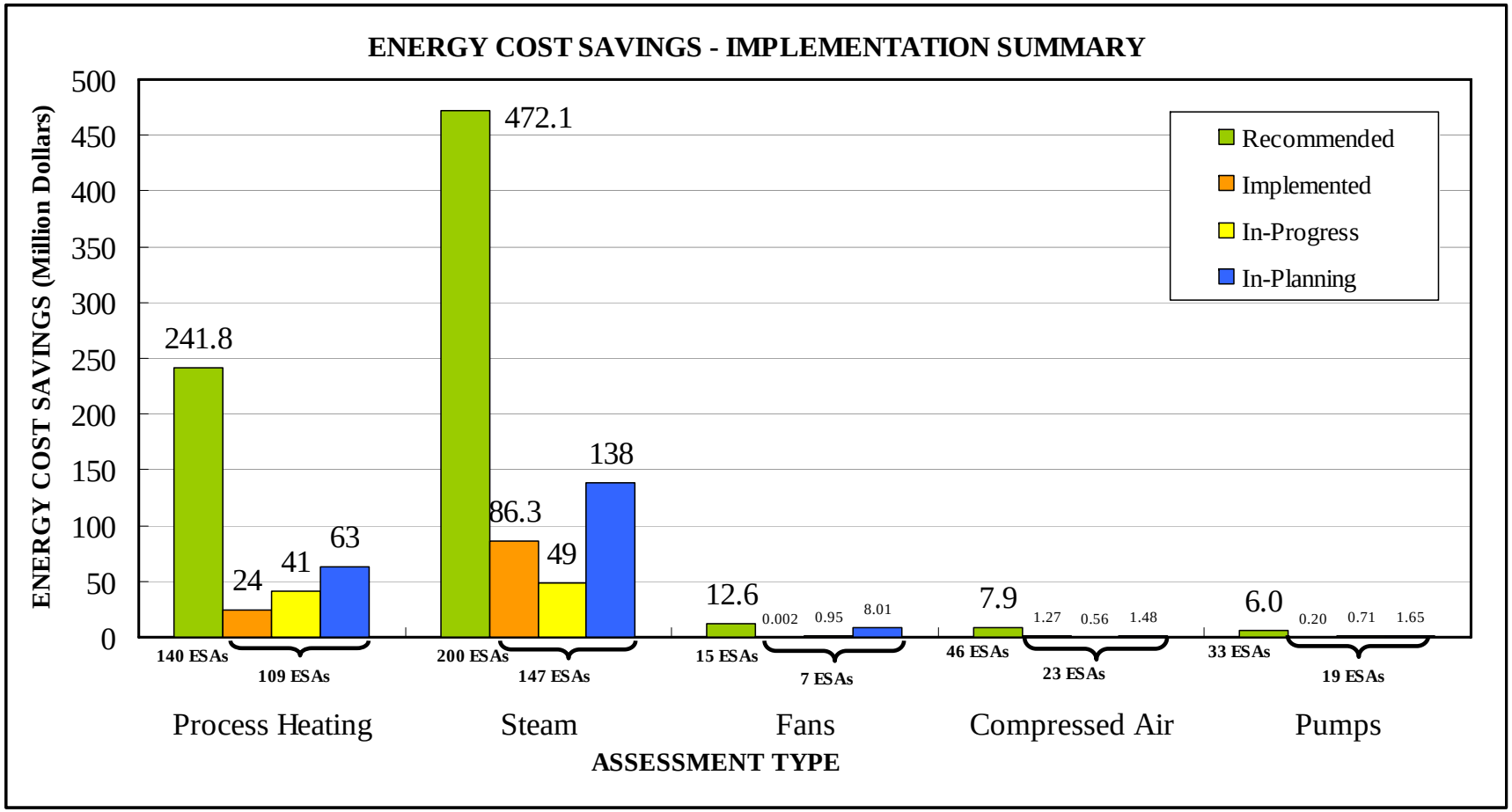
Energy cost:
Implemented: $112 million/year
In-Progress: $92 million/year
In-Planning: $212 million/year

Total 305 Assessments
(ESAs with follow-up information)

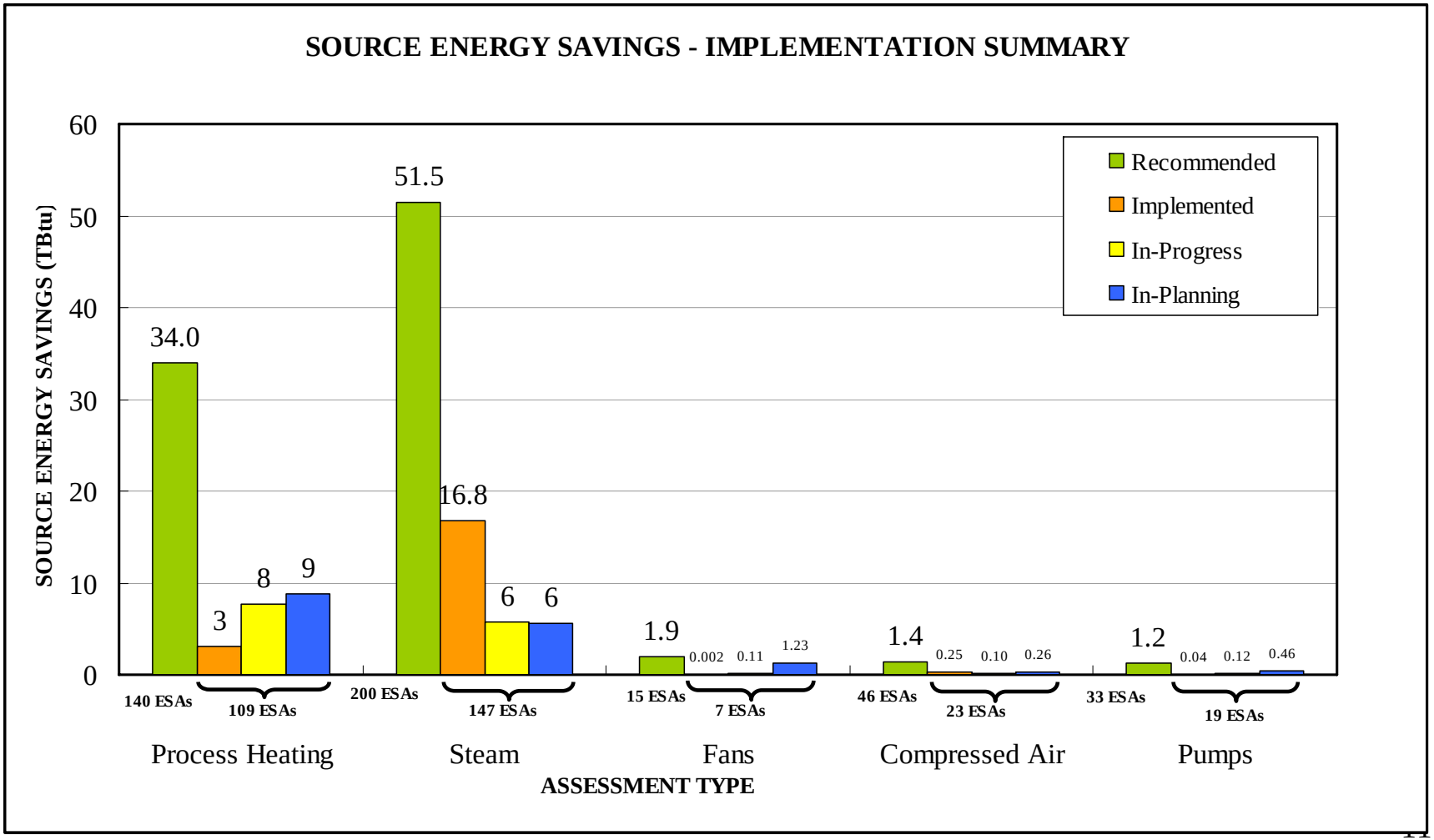
Based on 6, 12 and 24 months follow-up calls

CO_2 reduction:
Implemented: 1.41 million MTon/year
In-Progress: 0.88 million MTon/year
In-Planning: 1.55 million MTon/year

SUBSTANTIAL IDENTIFIED, IMPLEMENTED COST SAVINGS FROM PROCESS HEATING, STEAM ASSESSMENTS

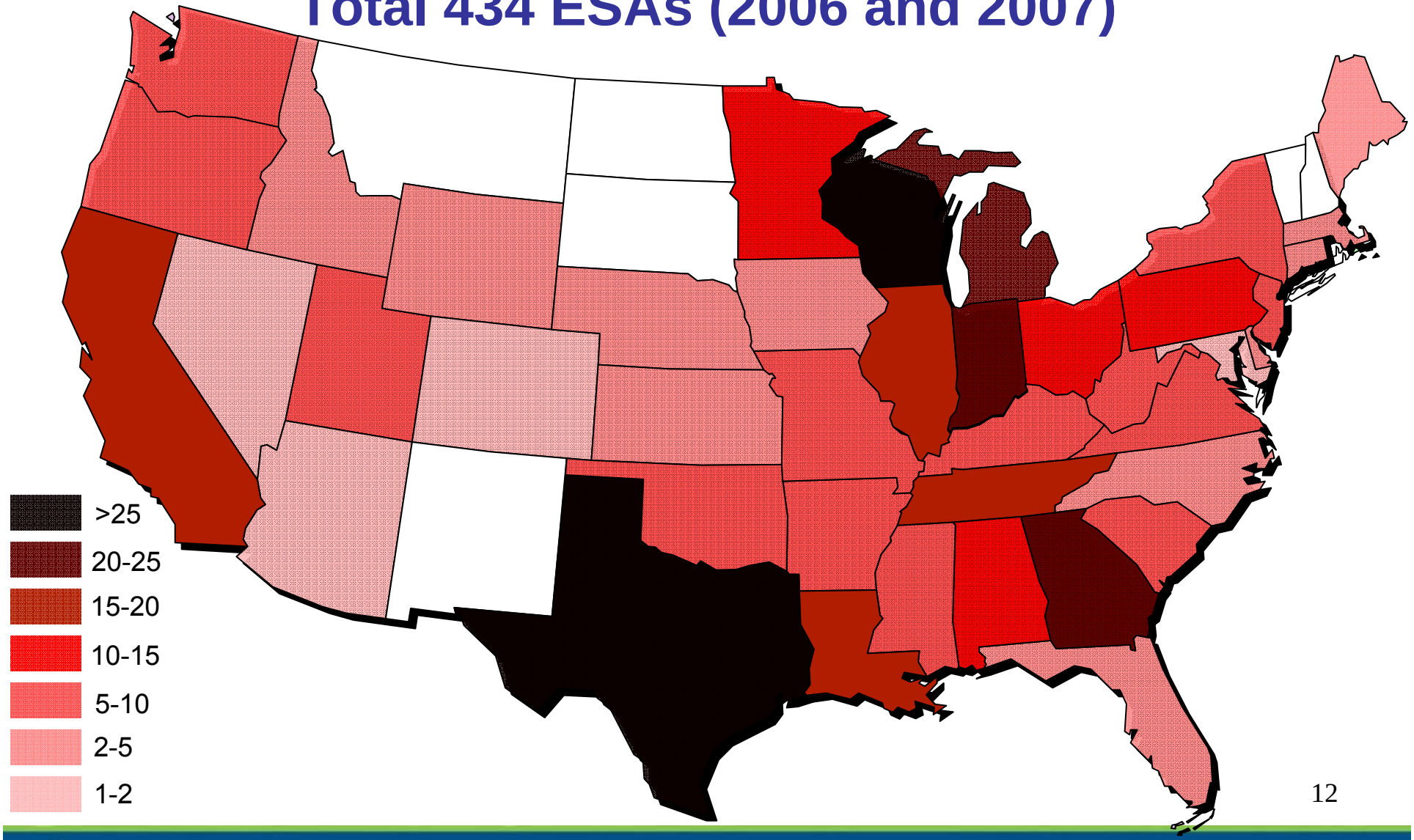


IDENTIFIED AND IMPLEMENTED SOURCE ENERGY SAVINGS

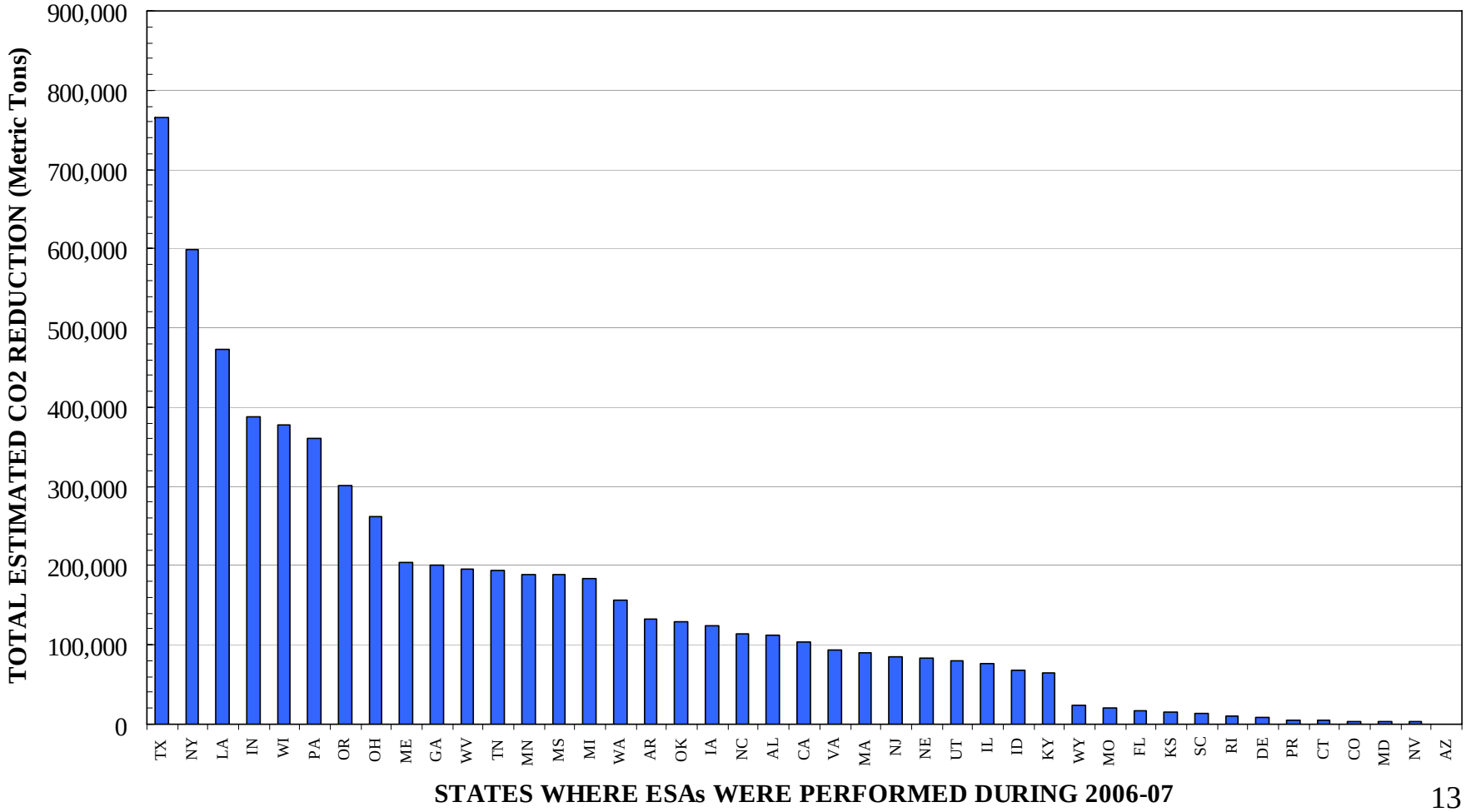


NUMBER OF ESAs PERFORMED – STATES

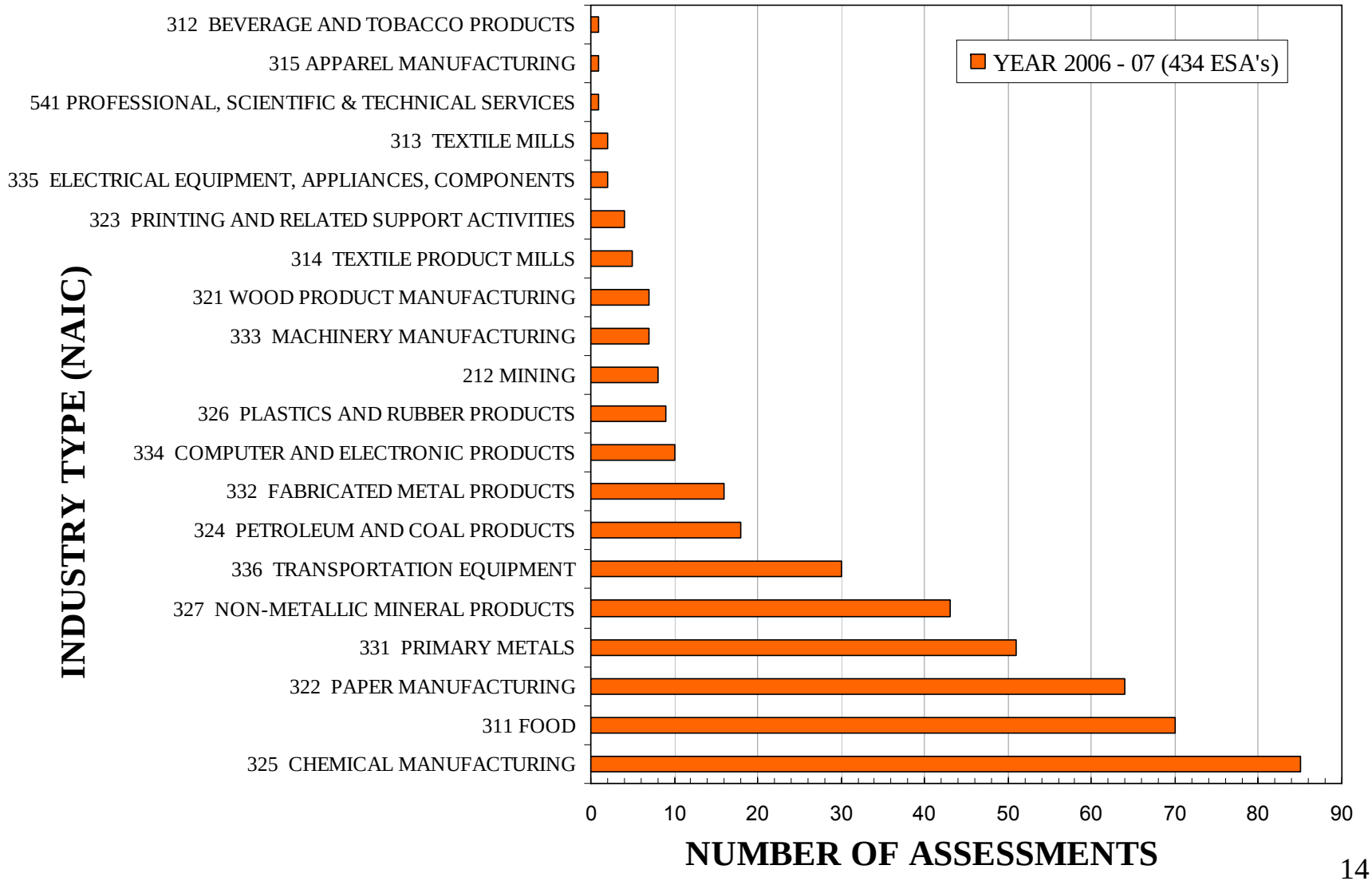
Total 434 ESAs (2006 and 2007)



TOTAL ESTIMATED CO_2 REDUCTIONS
6.36 MILLION METRIC TONS PER YEAR
(434 ESA's DURING 2006-2007)

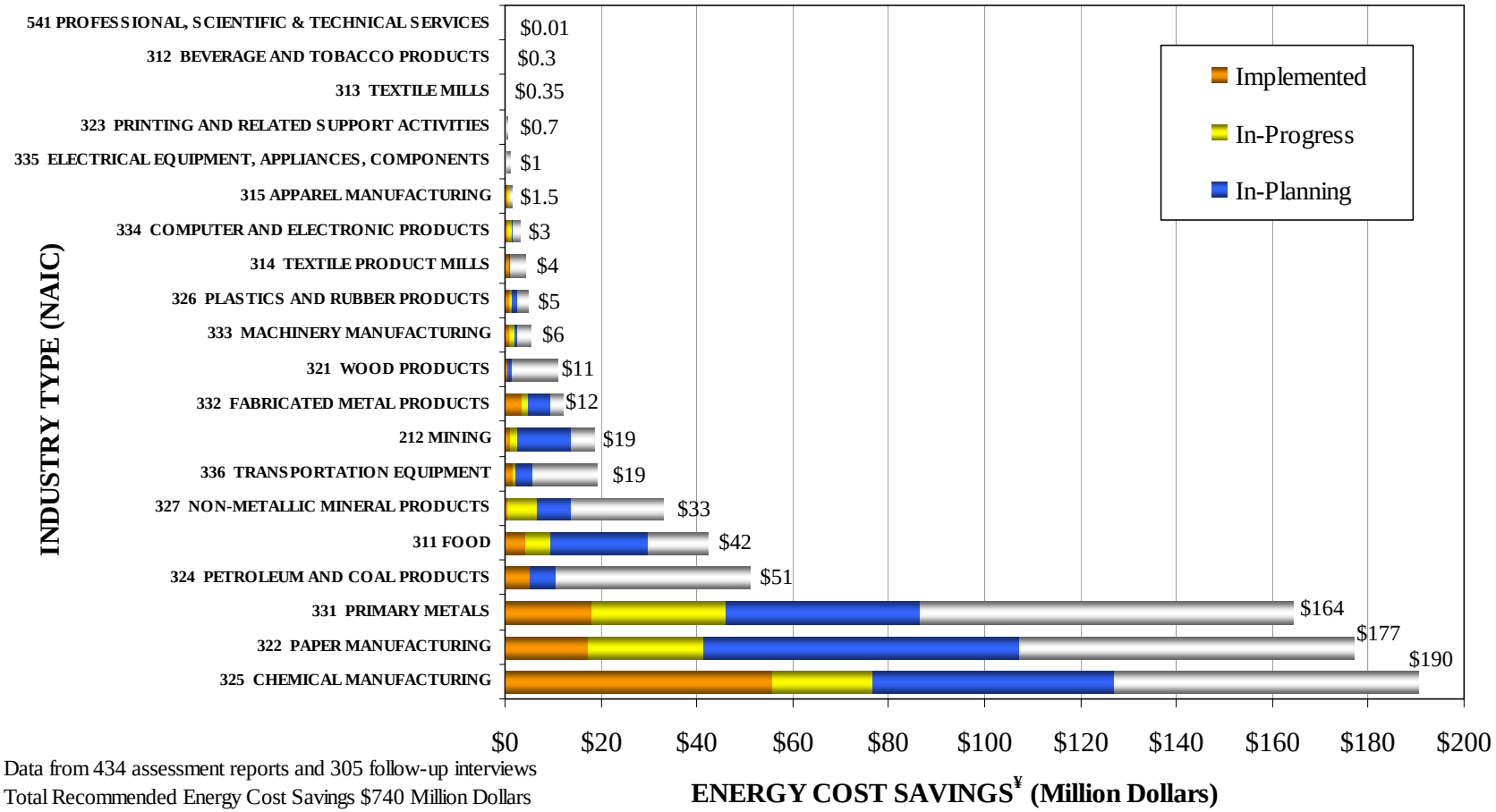


> 310 SAVE ENERGY NOW ASSESSMENTS - 5 MAJOR NAIC GROUPS



81% OF IMPLEMENTED COST SAVINGS TO DATE OCCURING IN 3 NAIC GROUPS

IMPLEMENTATION PROGRESS BY NAIC GROUP*



* Data from 434 assessment reports and 305 follow-up interviews

¥ Total Recommended Energy Cost Savings $740 Million Dollars

PLANT-LEVEL OVERVIEW

Identified Savings Per Plant

Average identified source energy savings = 208,170 MMBtu per plant per year

Average identified energy cost savings = $1.71 million per plant per year

Total 434 Assessments (ESAs with summary report)

Average identified CO_2 reduction = 14,695 Metric Ton per plant per year

Average % source energy savings identified 5.91% per plant per year

SUMMARY OF IDENTIFIED SAVINGS PER PLANT SUMMARY (System Type)

System Type	Average Recommended Source Energy Savings (MMBtu/plant per year)	Average Percent Source Energy Savings Recommended (%)	Average Recommended Cost Savings ($/plant per year)	Average Natural Gas Savings Recommended (MMBtu/plant per year)	Average CO_2 Savings Recommended (Metric Tons/plant per year)
Compressed Air	30,839	1.81	$172,522	606	1,804
Fans	129,109	4.25	$839,262	71,092	7,175
Process Heating	244,912	8.22	$1,739,758	173,916	14,204
Pumps	37,040	0.99	$182,343	2,832	2,155
Steam	257,587	6.18	$2,360,566	236,818	20,634

SUMMARY OF IDENTIFIED SAVINGS PER PLANT (State)

State Name	Average Recommended Source Energy Savings (MMBtu per plant per year)	Average Percent Source Energy Savings Recommended (%)	Average Natural Gas Savings Recommended (MMBtu per plant per year)	Average Recommended Cost Savings ($ per plant per year)	Average CO_2 Savings Recommended (MMBtu per plant per year)
NY	778,348	9.5	211,489	$3,157,894	66,513
ME	709,439	12.2	0	$4,345,838	68,304
WV	644,216	7.5	637,404	$6,119,981	32,544
IA	484,108	8.5	635,617	$3,148,036	24,879
OK	344,622	3.5	306,390	$2,585,060	18,511
OH	338,033	4.9	283,796	$2,604,047	18,719
NE	322,150	9.7	135,223	$1,628,043	20,947
IN	305,679	3.7	144,135	$1,874,056	18,454
PA	289,039	9.3	100,521	$1,585,262	18,004
TX	274,876	5.9	191,684	$2,276,451	15,028
MA	255,498	20.4	-207,123	$2,744,237	22,560
MN	251,019	7.8	202,031	$2,076,352	13,515
ID	226,956	6.5	40,829	$865,303	13,506
MS	207,642	6.0	194,365	$2,255,447	31,493
LA	206,947	4.1	564,162	$4,824,120	29,573

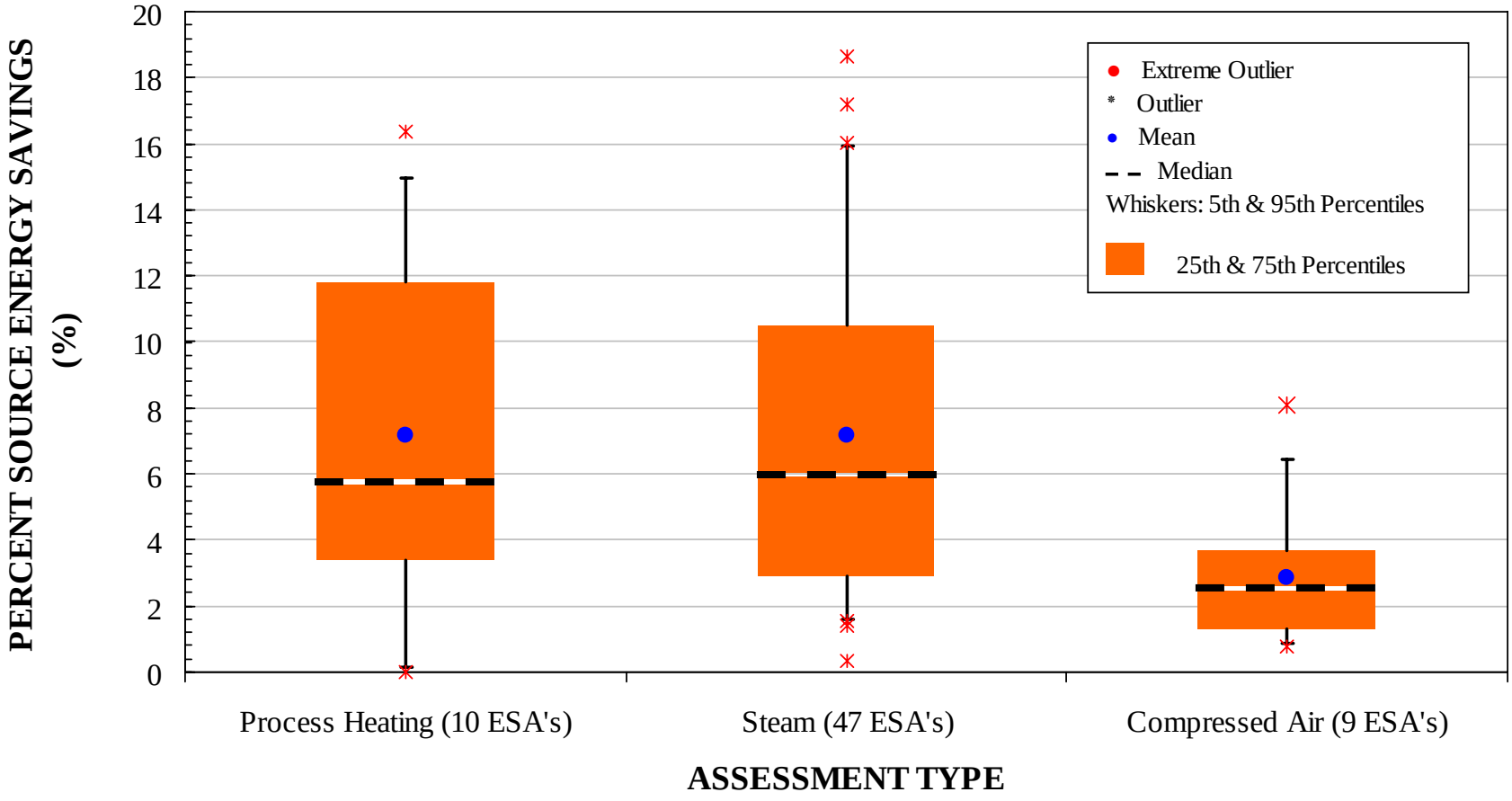
SUMMARY OF IDENTIFIED SAVINGS PER PLANT (NAICS Group)

NAIC GROUP	Average Recommended Source Energy Savings (MMBtu per plant per year)	Average Percent Source Energy Savings Recommended (%)	Average Recommended Cost Savings ($ per plant per year)	Average Natural Gas Savings Recommended (MMBtu per plant per year)	Average CO_2 Savings Recommended (Metric Tons per plant per year)
331 PRIMARY METALS	413,337	6.3	$3,223,796	325,788	22,121
212 MINNING	357,436	6.8	$2,343,376	237,494	21,019
321 WOOD PRODUCTS	347,778	9.8	$1,541,037	75,735	5,735
325 CHEMICAL MANUFACTURING	328,507	6.7	$2,240,247	219,296	21,681
324 PETROLEUM & COAL PRODUCTS	311,188	6.2	$2,834,144	337,570	16,604
322 PAPER MANUFACTURING	196,140	5.7	$2,764,340	240,111	24,413
315 APPAREL MANUFACTURING	184,894	13.1	$1,477,000	184,894	9,819
327 NON-METALLIC MINERAL PRODUCTS	180,011	6.8	$788,261	48,508	13,765
333 MACHINERY MANUFACTURING	105,485	9.2	$791,242	89,981	5,687
332 FABRICATED METAL PRODUCTS	88,860	4.8	$749,003	89,316	4,562

HOW CAN SEN ASSESSMENTS HELP MEET DOE's "25/10" GOAL?

- SEN assessments identified opportunities for savings within their designated systems
- SEN assessments were limited to single systems, and three day assessments
- The SEN expert applied system software tools on the fraction of the system that they could address in the assessment period
- Examination of savings by recommendation suggests good potential exists for supporting these goals

DISTRIBUTION OF PERCENT SOURCE ENERGY SAVINGS FROM SEN FOOD MANUFACTURING ASSESSMENTS - NAIC 311 (2006 - 07)



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NAICS 325 (Chemical Manufacturing) "Top 10"

ESA Recommendation	Frequency	Average Source Energy Savings Percent Recommended (%)	Payback Range
1.4 - Use of alternate fuel or energy source	7	10.7*	0 - 9 months
3.3 - Heat cascading - use of flue or Exhaust gas heat from higher temp. process to supply heat to lower temperature processes	7	6.6	9 months – 2 years
1.2 - Use an Alternate Fuel	5	3.0	0 - 9 months
1.1 - Reduce Steam Demand by Changing the Process Steam Requirements	27	2.7	9 months – 2 years
1.20 - Multiple Boiler Optimization	3	2.5	9 months – 2 years
1.21 - Reduce or Recover Vented Steam	7	2.4	9 months – 2 years
1.19 - Deaerator Heat Recovery - General	2	2.1	0 - 9 months
1.6 - Multiple Compressor Control (install / improve)	1	2.0	9 months – 2 years
1.18 - Feedwater Heat Recovery - General	3	2.0	9 months – 2 years
1.7 - Add or Modify Operation of Backpressure Steam Turbine	25	1.8	9 months – 2 years
1.1 - Reduce oxygen content of flue (exhaust) gases	11	1.6	9 months – 2 years

* Includes energy savings from switching to an opportunity fuel

PROCESS HEATING "TOP 10"

ESA Recommendation	Frequency	Average Source Energy Savings Percent Recommended (%)	Payback Range
1.4 - Use of alternate fuel or energy source	7	7.10*	9 months – 2 years
3.5 - Use of waste heat for water or air cooling, steam generation or absorption cooling	6	3.80	9 months – 2 years
5.1 - Furnace scheduling, loading, shut down - avoiding delays, waits, cooling between operations etc.	13	3.16	0 - 9 months
3.4 - Heat recovery from hot products or other heat sources (i.e. from walls) from a furnace - oven	23	3.10	9 months – 2 years
1.5 - Use of oxygen for combustion	17	2.71	9 months – 2 years
2.1 - Improving heat transfer in a furnace-oven	11	2.56	9 months – 2 years
1.3 - Use of proper heating methods - replace inefficient and uneconomical methods with economical/efficient system	18	2.49	9 months – 2 years
3.3 - Heat cascading - use of flue or Exhaust gas heat from higher temp. process to supply heat to lower temperature processes	32	2.46	9 months – 2 years
3.2 - Load or charge preheating using heat from flue or exhaust gas or other source of waste heat	23	1.49	9 months – 2 years

* Includes energy savings from switching to an opportunity fuel

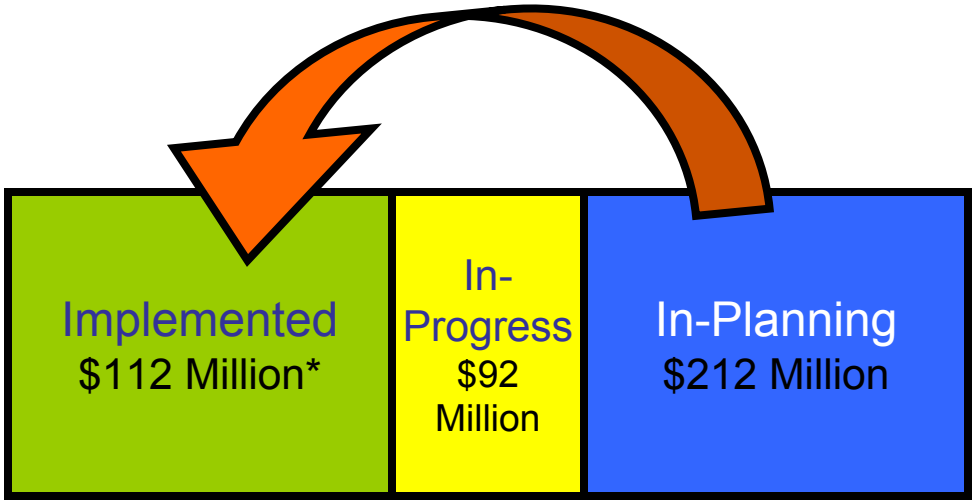
Steam "Top 10"

ESA Recommendation	Frequency	Average Source Energy Savings Percent Recommended (%)	Payback Range
2.2 - Clean heat transfer surfaces - radiant tubes, heat exchangers, heater tubes, electrical heating elements	1	2.5	9 months – 2 years
1.1 - Reduce Steam Demand by Changing the Process Steam Requirements	80	2.3	9 months – 2 years
1.2 - Use an Alternate Fuel*	21	1.6	9 months – 2 years
1.20 - Multiple Boiler Optimization	11	1.3	9 months – 2 years
1.18 - Feedwater Heat Recovery - General	14	1.2	9 months – 2 years
1.3 - Change Boiler Efficiency	101	1.1	9 months – 2 years
1.21 - Reduce or Recover Vented Steam	19	1.0	9 months – 2 years
1.19 - Deaerator Heat Recovery - General	4	1.0	0 - 9 months
1.12 - Modify the Medium Pressure Condensate Flash System	3	0.9	0 - 9 months
1.7 - Add or Modify Operation of Backpressure Steam Turbine	49	0.9	2 – 4 years

* Includes energy savings from switching to an opportunity fuel

CHALLENGES TO THE IMPLEMENTATION

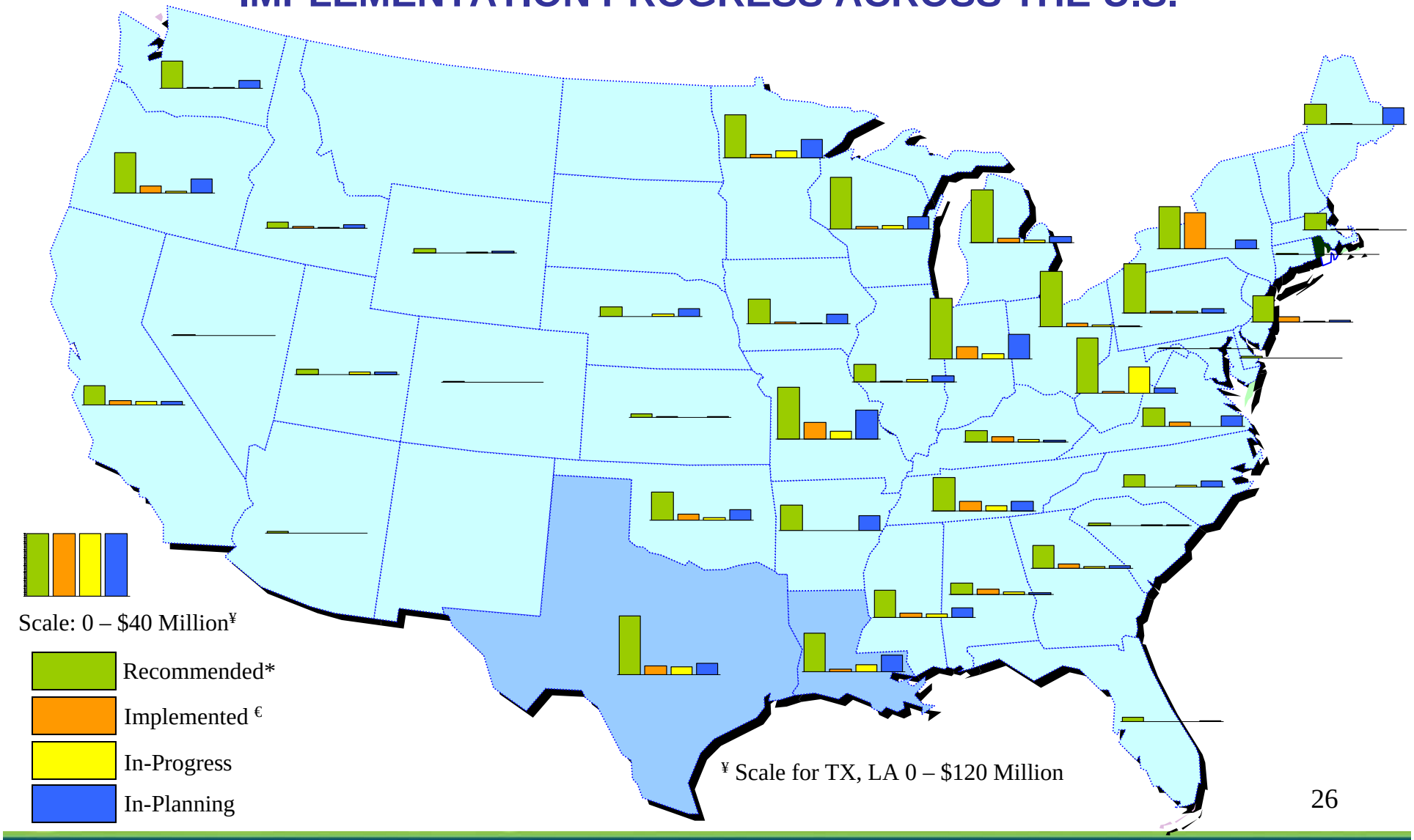
How to increase SEN implementation rate?



* Implementation savings from 305 assessments

SAVE ENERGY NOW ASSESSMENTS

IMPLEMENTATION PROGRESS ACROSS THE U.S.

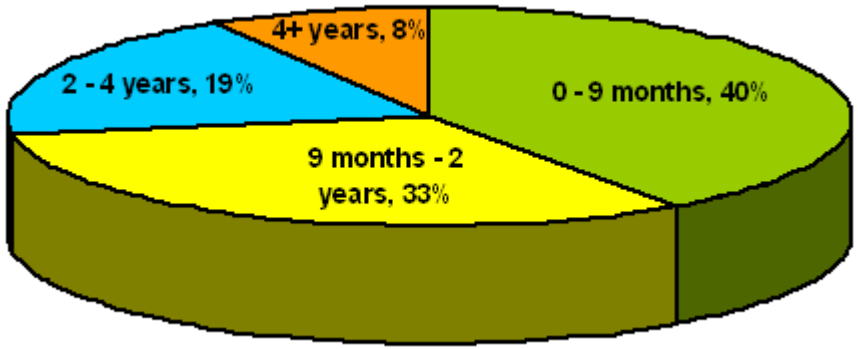


* Recommendation savings from 425 assessments

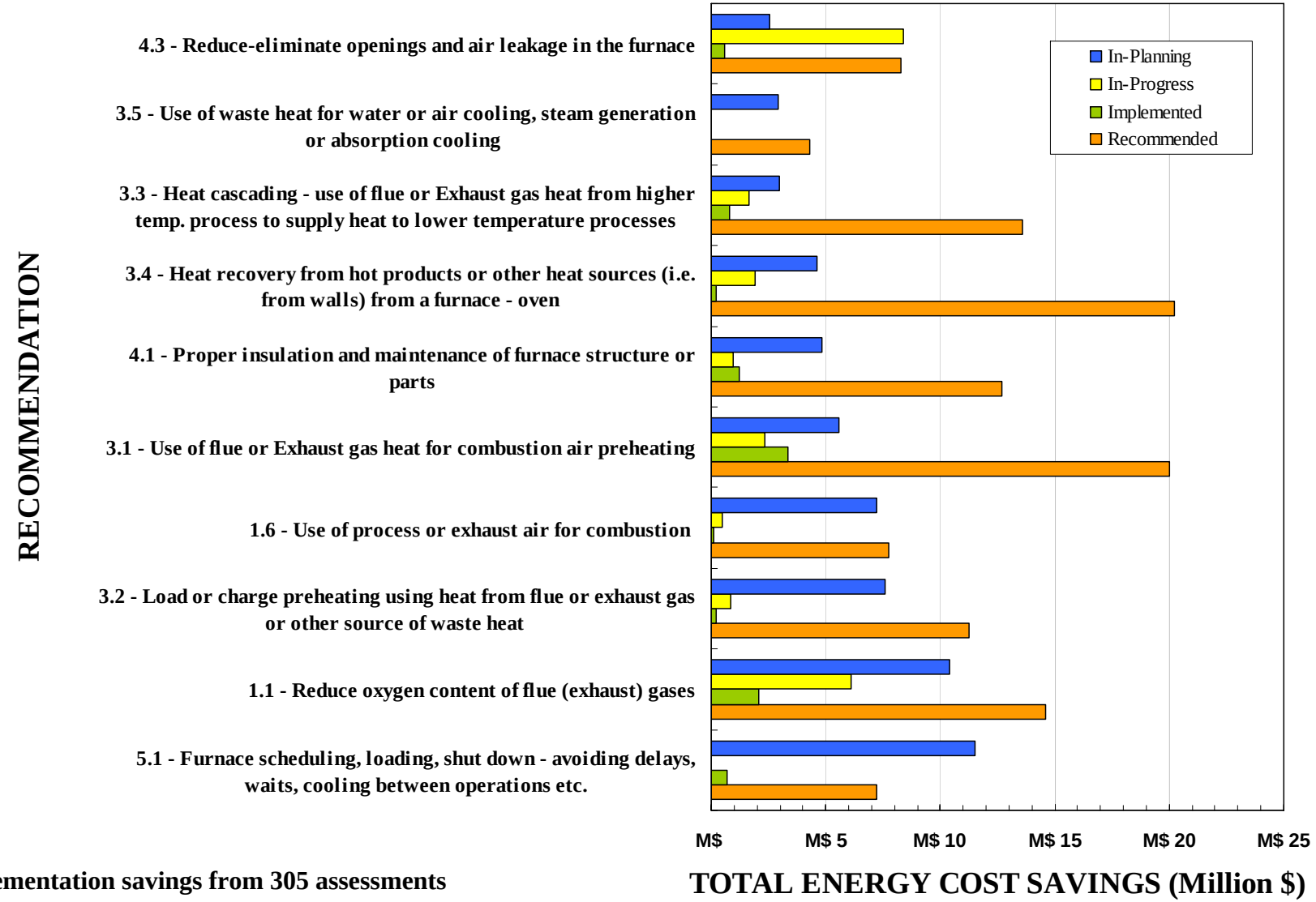
€ Implementation savings from 286 assessments

PAYBACK – NOT THE ONLY IMPEDEMENT

- Over 73% of recommended actions had paybacks of less than 2 years.
- 40% of recommended actions had paybacks of less than 9 months.
- Only 8% recommendations had paybacks of more than 4 years



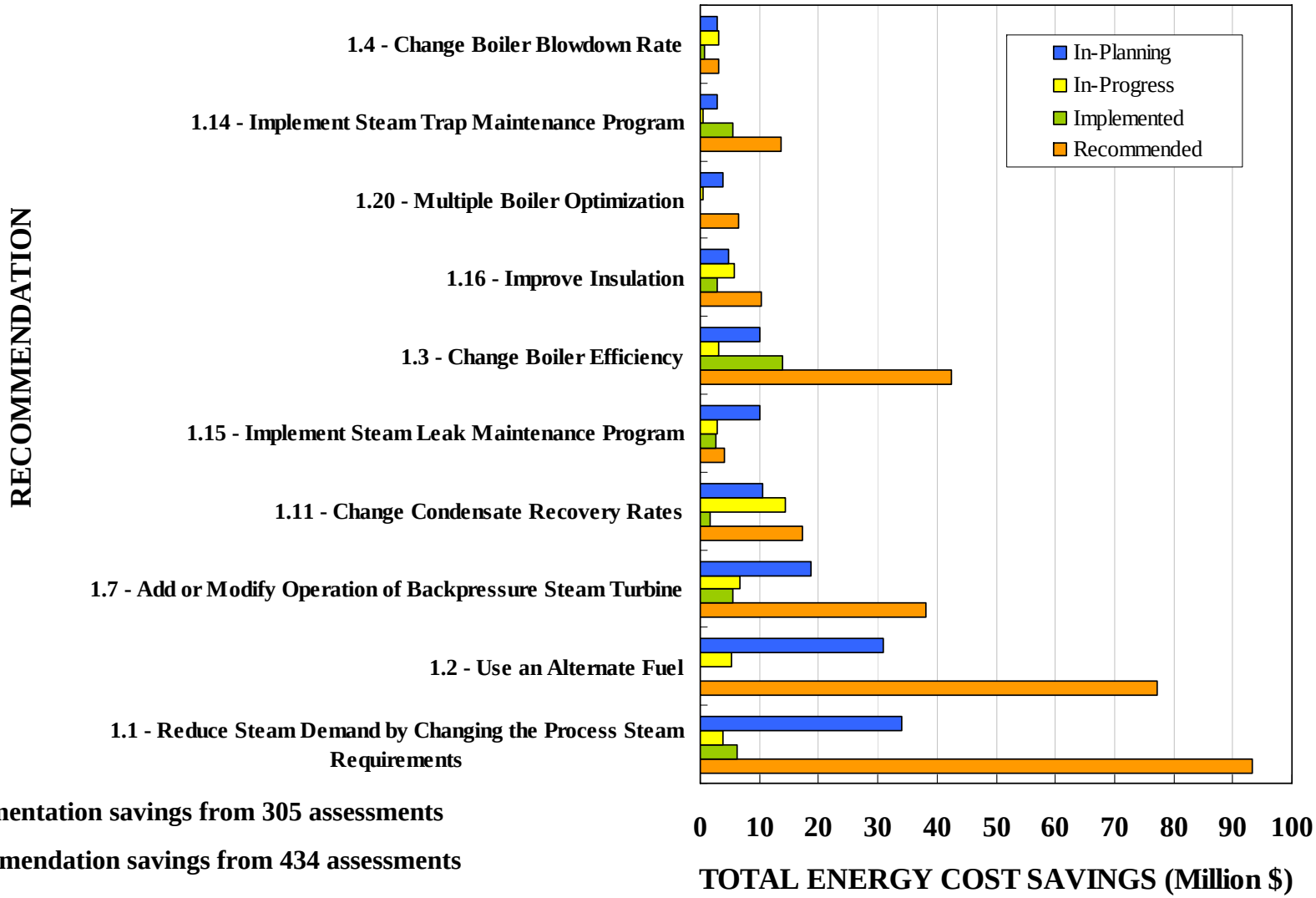
TOP TEN PROCESS HEATING OPPORTUNITIES (STILL IN THE PLANNING STAGE…)



*** Implementation savings from 305 assessments**

*** Recommendation savings from 434 assessments**

TOP TEN STEAM OPPORTUNITIES
(STILL IN THE PLANNING STAGE…)



*** Implementation savings from 305 assessments**

*** Recommendation savings from 434 assessments**

THE MAJOR BARRIERS TO IMPLEMENTATION

- Further examination finds an unattractive return on investment
- A change in the company policy emphasizing energy reduction
- Process related limitations, concern regarding operational changes
- Limitations of the current available technology or design
- Red flags by the employees or political reasons

THE MAJOR BARRIERS TO IMPLEMENTATION (cont.)

- Limited in-house engineering availability
- Company merger and new policies
- Budget priorities and budget cycle
- Operational downtime and impact on the production, scheduling issues

CONCLUSIONS

- SEN assessments are identifying significant savings opportunities for U.S. industry.
- Process heating and steam comprise approximately 95% of SEN savings at the program level.
- Process heating and steam assessments generate the most identified savings at the plant level.
- SEN-system-based approach can be used by U.S industry to help achieve “25/10” goal.
- Progress is underway on implementation, however the implementation gap remains a challenge to be addressed.
- Payback is not the major impediment to implementation. Dialogue should focus on other major issues identified.

For More Information

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