Energy Efficiency Potential: Results of Studies by ECMB

Presentation to CEAB

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Overview of Presentation

- Approach
- Summary of results
- Technical and economic potential
- Achievable potential
- Top 20 measures
- Program scenarios

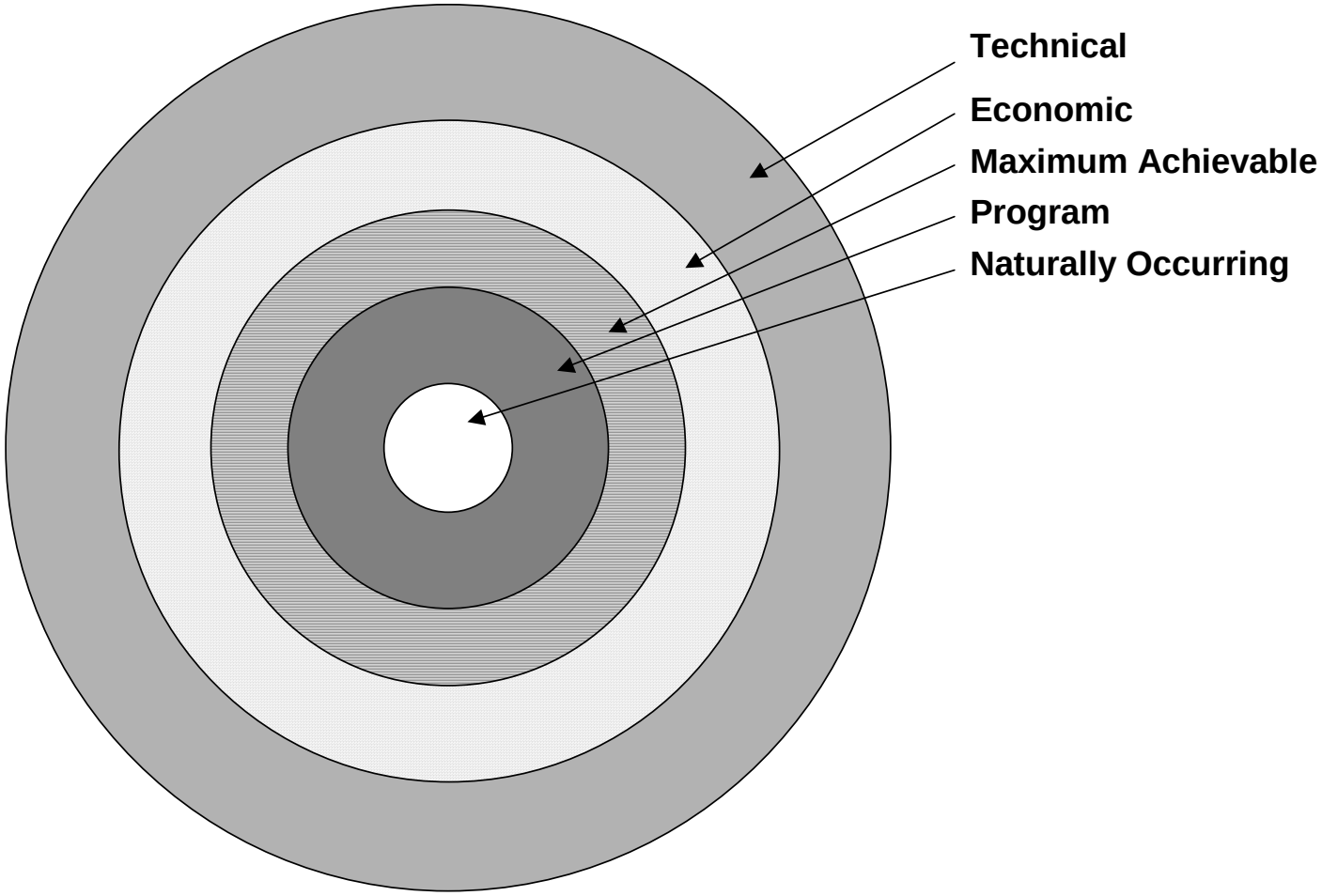
- Electric potential study
- Gas potential study – C&I only

- Both studies conducted by KEMA Consulting

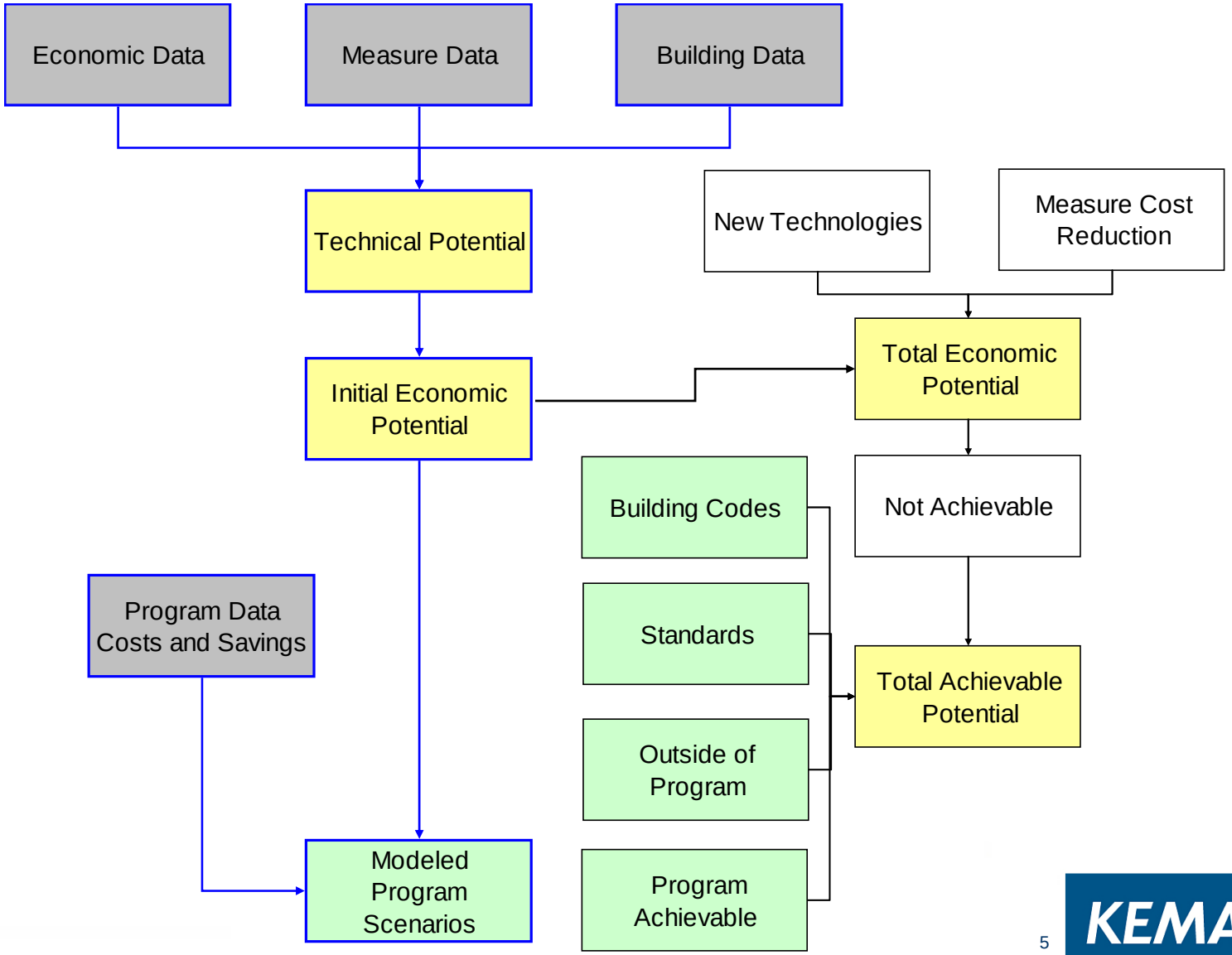
What is a Potential Study?

- Provides an estimate of how much savings can potentially be achieved and at what cost
- Provides a benchmark which is useful for long term conservation planning
- An additional tool that the Companies and ECMB could use during the budget and goal setting process
- Could be used to target specific measures or groups of measures
- Enhances program designs

Typical View of EE Potential



Overview of Approach in the Connecticut Studies



Types of Potential in the Reports

- Technical Potential – the complete penetration of all measures analyzed in applications where they were deemed technically feasible
- Two Economic Potentials – the technical potential of those energy-efficiency measures that are cost-effective
  - Initial Economic Potential – cost effectiveness based on current technologies and costs
  - Total Economic Potential – takes into account emerging technologies and reductions in measure costs over time

Types of Potential, Continued

- Total Achievable Potential – maximum energy efficiency savings from all sources (all programs, policies, and outside-of-program)

- Program Achievable Potential – how much energy efficiency programs can save, while accounting for the simultaneous effects of building codes, standards, and outside-of-program savings.

Program Funding Scenarios

- Program Funding Scenarios – savings that would occur in response to specific program funding and measure incentive levels in a 10 year time frame
  - Current Program Funding Scenario - approximates the 2009 Program Plan budget in its **first year**
  - Expanded Program Funding Scenario - approximates the instantaneous program achievable potential, subject to the limitations of stock turnover and current technologies and measure costs

Bottom Line: Summary Results of the Electric and Gas Potential Studies

Potential energy savings over a ten year period, 2009-2018

	Electric (GWh)	Natural Gas (Dth)
Technical Potential	10,714	11,568,192
(technically feasible)	*36%*	*29%*
Total Economic	10,722	10,100,924
(cost-effective)	*36%*	*25%*
Total Achievable	9,114	8,585,785
(achievable from all policies)	*31%*	*22%*
Program Achievable	6,616	6,626,397
(achievable from programs)	*23%*	*17%*

Electric Study Results

Overall Energy Savings in GWh - Net

Sector	GWH								
							Program Achievable Savings per KEMA Model		
	Base Energy Use	Technical Savings	Initial Economic Savings	Total Economic Savings	Total Achievable Savings	Program Achievable Savings	Net Base Funding Achievable Savings	Net Current Funding Achievable Savings	Net Accelerated Funding Achievable Savings
Residential Existing	12,398	4,263	3,642	4,007	0	0	836	937	1,274
Residential New	189	30	21	23	0	0	41	42	45
Subtotal	12,587	4,294	3,663	4,029	3,425	2,221	878	978	1,318
Savings % of Base		**34%**	**29%**	**32%**	**27%**	**18%**	**7%**	**8%**	**10%**
10 Year Average Program Budget							$41,341,688	$49,030,459	$72,087,077
Commercial Existing	12,652	5,038	4,815	5,296			1,018	1,188	3,208
Commercial New	193	86	86	95			422	469	476
Subtotal	12,845	5,124	4,901	5,391	4,582	3,485	1,440	1,657	3,684
Savings % of Base		**40%**	**38%**	**42%**	**36%**	**27%**	**11%**	**13%**	**29%**
10 Year Average Program Budget							$30,512,795	$37,626,308	$94,276,326
Industrial	3,965	1,296	1,184	1,302	1,107	910	629	698	908
Savings % of Base		**33%**	**30%**	**33%**	**28%**	**23%**	**16%**	**18%**	**23%**
10 Year Average Program Budget							$16,230,450	$19,084,256	$39,185,843
Total	29,397	10,714	9,748	10,722	9,114	6,616	2,946	3,333	5,910
Savings % of Base		**36%**	**33%**	**36%**	**31%**	**23%**	**10%**	**11%**	**20%**
10 Year Average Program Budget							$88,084,933	$105,741,022	$205,549,247

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Overall Peak Demand Reductions in MW - Net

Sector	MW								
							Program Achievable Savings per KEMA Model		
	Base Energy Use	Technical Savings	Initial Economic Savings	Total Economic Savings	Total Achievable Savings	Program Achievable Savings	Net Base Funding Achievable Savings	Net Current Funding Achievable Savings	Net Accelerated Funding Achievable Savings
Residential Existing	2,873	1,023	802	882			132	144	208
Residential New	44	12	6	7			17	17	19
Subtotal	2,917	1,035	808	889	755	566	149	161	227
Savings % of Base		**35%**	**28%**	**30%**	**26%**	**19%**	**5%**	**6%**	**8%**
10 Year Average Program Budget							$41,341,688	$49,030,459	$72,087,077
Commercial Existing	2,937	994	923	1,016			189	221	613
Commercial New	45	17	17	19			82	92	93
Subtotal	2,982	1,011	940	1,034	879	652	272	313	706
Savings % of Base		**34%**	**32%**	**35%**	**29%**	**22%**	**9%**	**10%**	**24%**
10 Year Average Program Budget							$30,512,795	$37,626,308	$94,276,326
Industrial	919	230	212	233	198	163	110	124	162
Savings % of Base		**25%**	**23%**	**25%**	**22%**	**18%**	**12%**	**13%**	**18%**
10 Year Average Program Budget							$16,230,450	$19,084,256	$39,185,843
Total	6,818	2,257	1,960	2,156	1,832	1,380	531	597	1,095
Savings % of Base		**33%**	**29%**	**32%**	**27%**	**20%**	**8%**	**9%**	**16%**
10 Year Average Program Budget							$88,084,933	$105,741,022	$205,549,247

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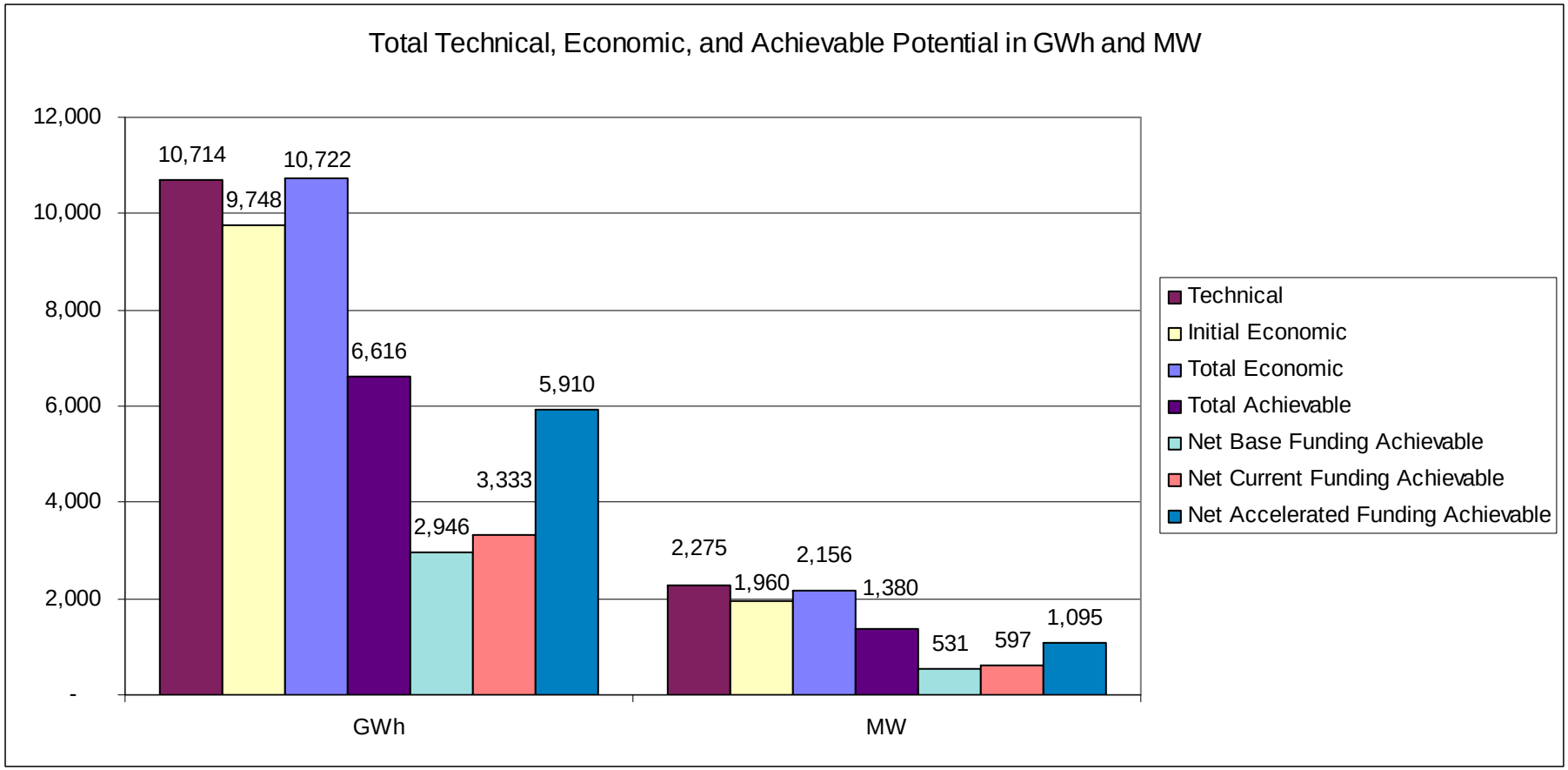
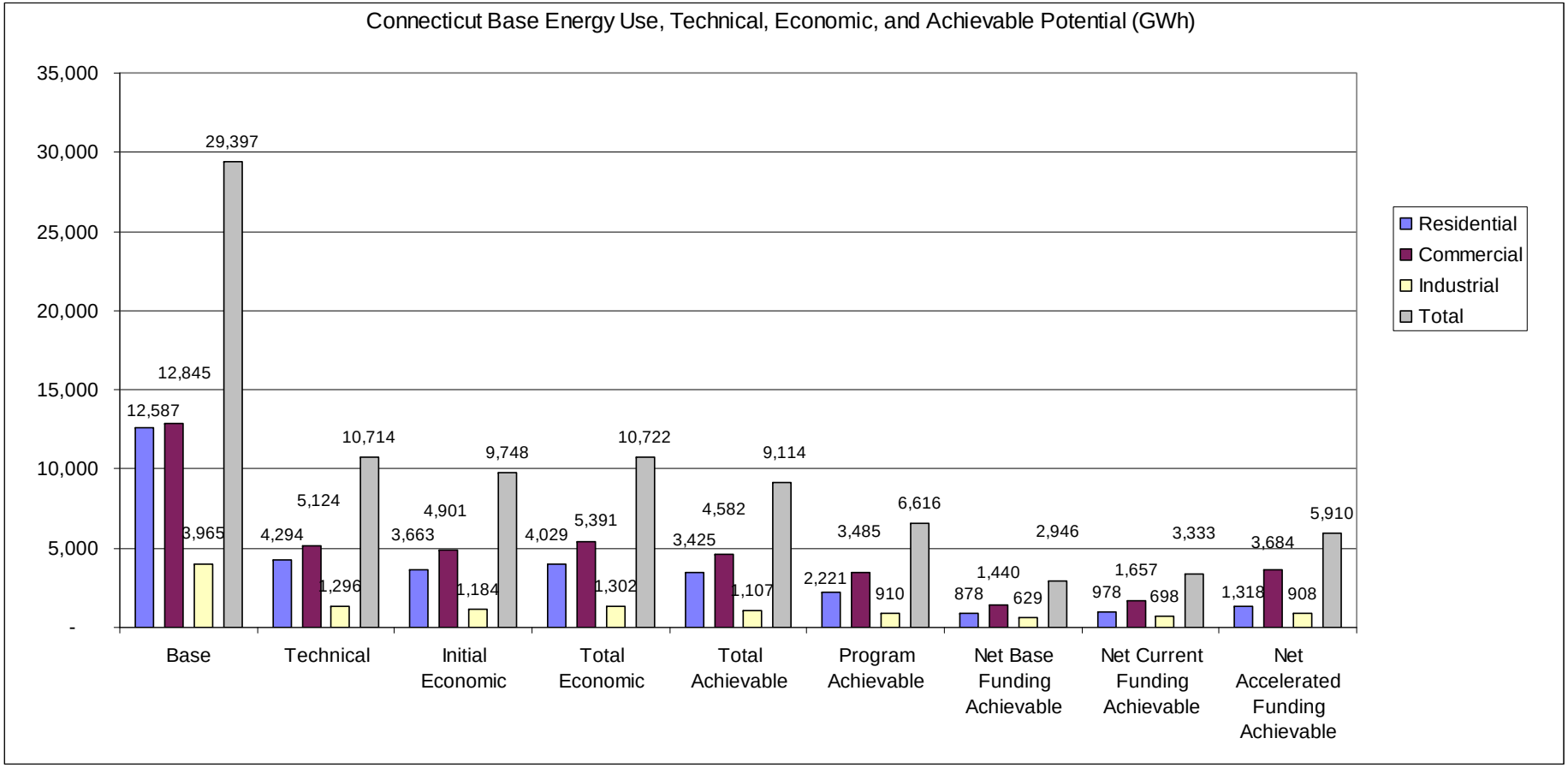
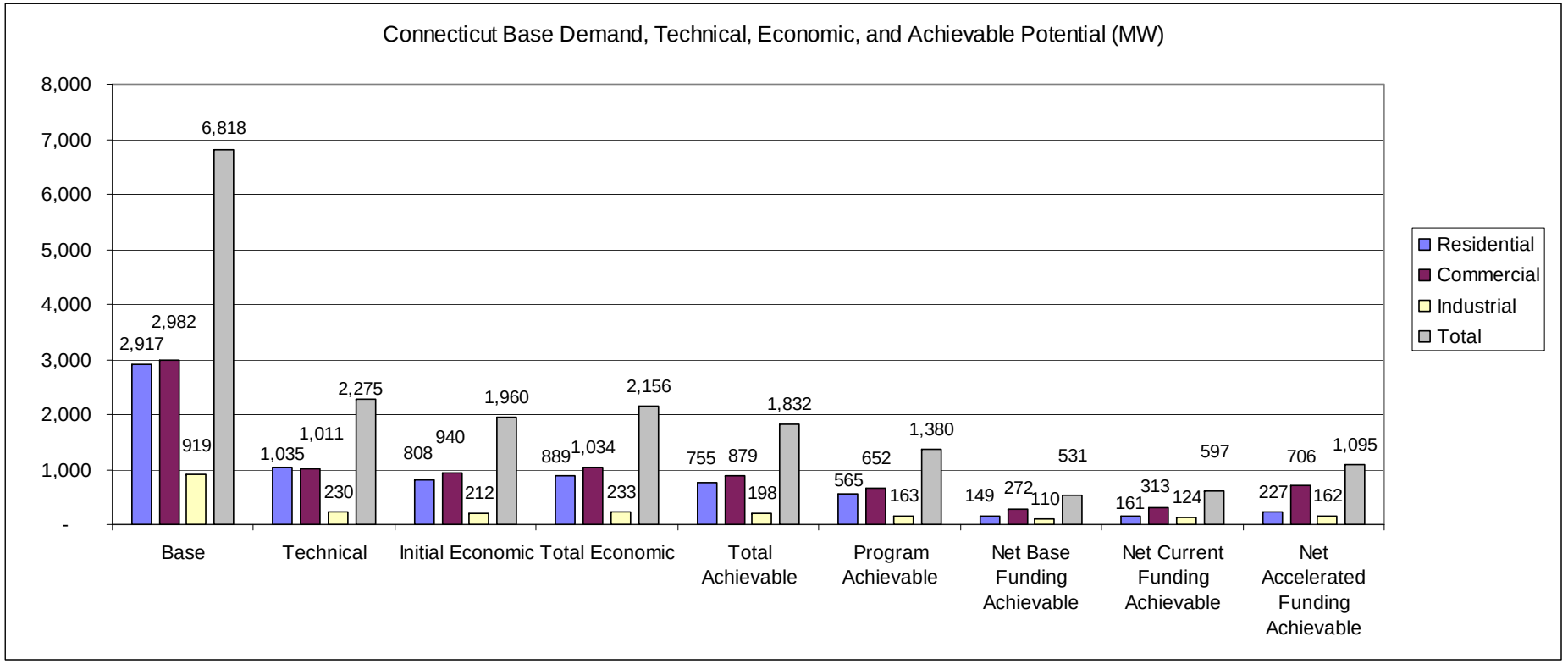
Summary of Results: GWh and MW



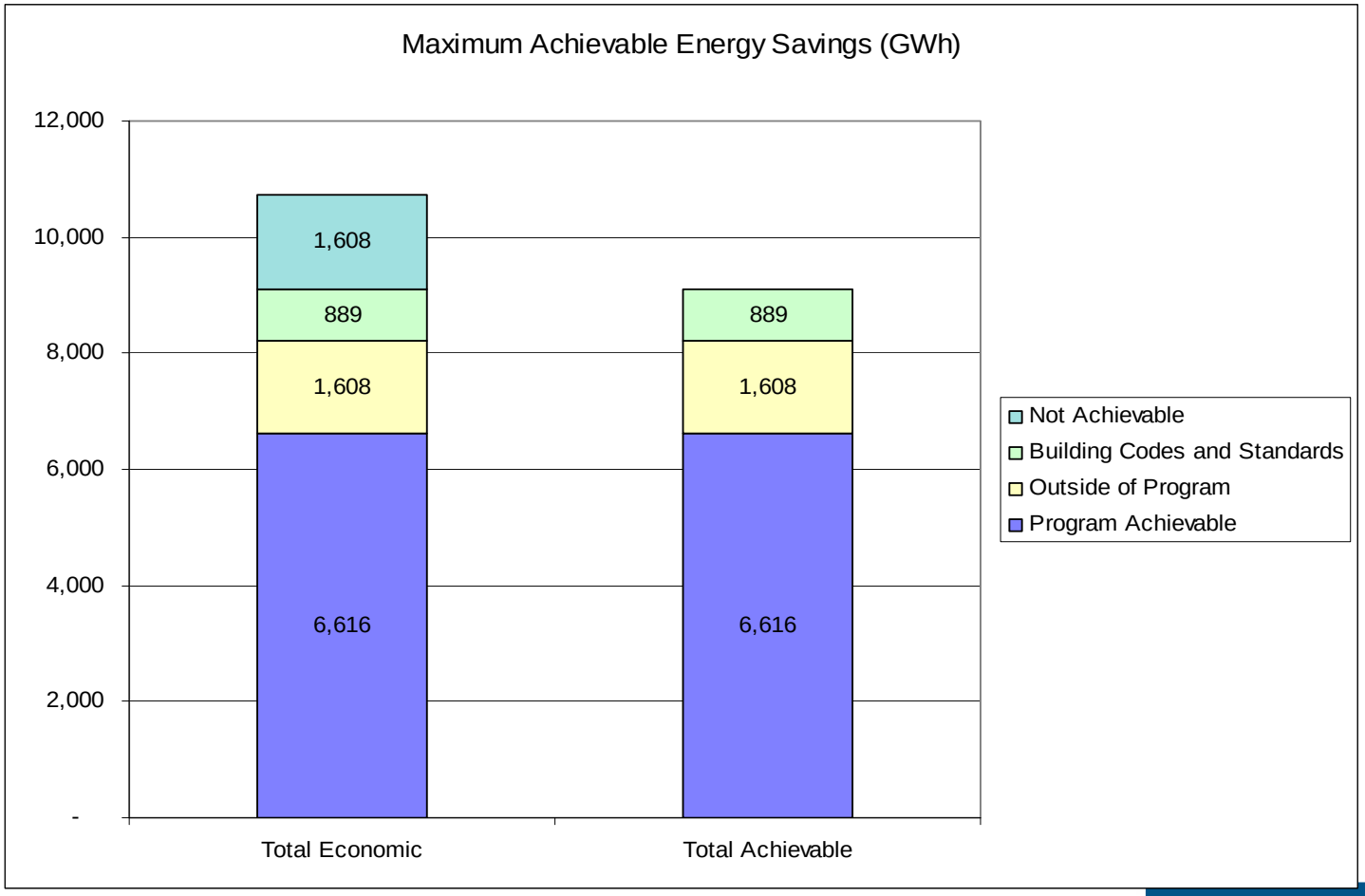
Net GWh Results



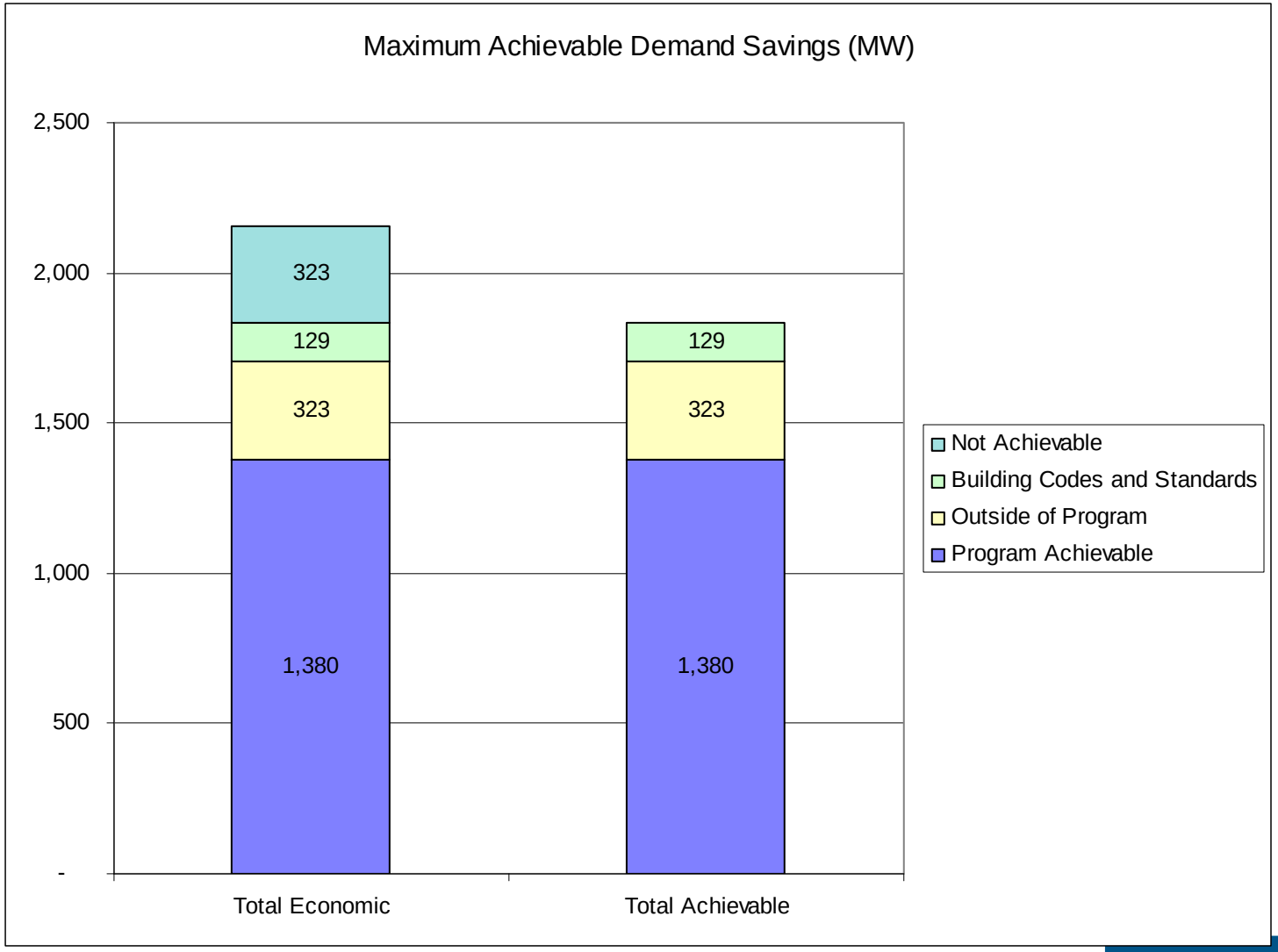
New MW Results



Total Economic Versus Total Achievable (GWh)



Total Economic Versus Total Achievable (MW)



Comparison of Achievable Cases: Results of Program Scenarios (Economic Modeling)

		Base Funding Case			Current Funding Case			Accelerated Funding Case		
		Budget	Net kWh	Net kW	Budget	Net kWh	Net kW	Budget	Net kWh	Net kW
UI Residential	Model	$5,841,322	136,677,602	22,640	$6,841,059	156,026,155	26,228	$16,226,935	282,860,937	52,627
	Plan	$5,980,418	128,225,108	20,132	$6,886,421	154,934,766	24,181	$16,704,120	288,619,073	48,697
	% Difference	**-2.33%**	**6.59%**	**12.45%**	**-0.66%**	**0.70%**	**8.47%**	**-2.86%**	**-2.00%**	**8.07%**
CL&P Residential	Model	$35,500,366	740,853,188	126,230	$42,189,400	822,310,506	134,622	$55,860,142	1,035,281,478	174,143
	Plan	$35,127,280	692,777,755	116,987	$42,683,107	842,044,984	142,167	$57,935,411	1,012,424,416	173,854
	% Difference	**1.06%**	**6.94%**	**7.90%**	**-1.16%**	**-2.34%**	**-5.31%**	**-3.58%**	**2.26%**	**0.17%**
Commercial	Model	$30,512,795	1,439,722,531	271,728	$37,626,308	1,657,014,423	312,552	$94,276,326	3,683,926,186	705,787
Industrial	Model	$16,230,450	628,648,670	110,273	$19,084,256	697,526,536	123,536	$39,185,843	908,140,202	162,286
C&I Total	Model	$46,743,245	2,068,371,201	382,002	$56,710,564	2,354,540,959	436,088	$133,462,170	4,592,066,388	868,073
	Plan	$46,472,561	1,981,287,015	325,024	$56,357,574	2,399,566,464	393,917	$126,472,499	4,471,919,833	733,861
	% Difference	**0.58%**	**4.40%**	**17.53%**	**0.63%**	**-1.88%**	**10.71%**	**5.53%**	**2.69%**	**18.29%**
Total	Model	$88,084,933	2,945,901,990	530,872	$105,741,022	3,332,877,620	596,938	$205,549,247	5,910,208,803	1,094,843
	Plan	$87,580,260	2,802,289,878	462,143	$105,927,102	3,396,546,214	560,265	201,112,030	5,772,963,322	956,413
	% Difference	**0.58%**	**5.12%**	**14.87%**	**-0.18%**	**-1.87%**	**6.55%**	**2.21%**	**2.38%**	**14.47%**

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Current Funding Case - KWh

	Current Budget	kWh				Year 1 Budget	Average 10 Year Budget
		Net	Naturally Occuring		Total		
			Outside of Program	Free Riders			
Residential	Existing	649,330,139	25,582,712	16,537,778	691,450,629	$29,757,583	$28,811,991
	Existing CFLs	287,317,385	9,889,355	23,075,162	320,281,903	$10,623,017	$13,599,677
	New	41,689,137	973,621	2,256,407	44,919,165	$1,884,179	$6,618,790
	Total	978,336,661	36,445,688	41,869,347	1,056,651,697	$42,264,779	$49,030,459
	% of total load	8%			8%		
Commercial	Existing	1,112,100,086	73,529,623	399,425,654	1,585,055,363	$17,317,439	$23,013,131
	CFLs	75,950,995	48,284,250	235,740,750	359,975,995	$1,795,399	$1,619,858
	New	468,963,342	4,126,108	23,381,280	496,470,730	$12,033,818	$12,993,318
	Total	1,657,014,423	125,939,981	658,547,684	2,441,502,087	$31,146,656	$37,626,308
	% of total load	13%			19%		
Industrial	Existing	697,526,536	31,968,328	140,833,447	870,328,311	$16,102,943	$19,084,256
	% of total load	18%			22%		
Total		3,332,877,620	194,353,998	841,250,478	4,368,482,096	$89,514,378	$105,741,022
	% of total Load	11%			15%		

Accelerated Funding Case - KWh

	Accelerated Budget	kWh				Year 1 Budget	Average 10 Year Budget
		Net	Naturally Occuring		Total		
			Outside of Program	Free Riders			
Residential	Existing	844,945,380	25,582,712	16,537,778	887,065,870	$42,259,171	$46,867,343
	Existing CFLs	428,565,276	9,889,355	23,075,162	461,529,794	$11,986,458	$17,409,794
	New	44,631,759	1,117,593	2,589,936	48,339,288	$1,996,588	$7,809,940
	Total	1,318,142,415	36,589,660	42,202,876	1,396,934,952	$56,242,216	$72,087,077
	% of total load	10%			11%		
Commercial	Existing Retrofit	2,329,531,908	65,733,858	193,308,548	2,588,574,314	$82,532,306	$52,105,110
	Existing Replace on Burnout	466,765,431	18,154,310	17,782,939	502,702,681	$10,429,670	$24,629,064
	CFLs	411,713,402	26,120,938	127,531,637	565,365,977	$6,138,673	$6,264,578
	New	475,915,445	4,126,108	23,381,280	503,422,833	$10,333,818	$11,277,574
	Total	3,683,926,186	114,135,214	362,004,404	4,160,065,804	$109,434,467	$94,276,326
	% of total load	29%			32%		
Industrial	Replace on Burnout	151,507,157	1,997,325	8,750,503	162,254,985	$7,800,052	$18,641,162
	Retrofit	756,633,045	25,060,080	110,399,812	892,092,937	$20,365,152	$20,544,681
	Total	908,140,202	27,057,405	119,150,315	1,054,347,922	$28,165,204	$39,185,843
	% of total load	23%			27%		
Total		5,910,208,803	177,782,279	523,357,595	6,611,348,677	$193,841,888	$205,549,247
	% of total Load	20%			22%		

Top 20 Industrial Measures - Economic

Industrial Top Twenty by Economic Potential (GWh)

Base	Measure Number	Measure Name	Technical GWh	TRC	Economic GWh
810	814	Continuous Dimming, Fluorescent Fixtures	80.28	1.81	80.28
100	105	Compressed Air - System Optimization - 30% energy savings	79.54	17.36	79.54
300	305	Pumps - System Optimization - 30% savings	71.99	3.07	71.99
300	303	Pumps - Controls - 40% savings	63.83	9.32	63.83
400	434	Generic Drives Improvements 20%	61.64	1.41	61.64
200	203	Fans - Controls - 40% savings	55.50	2.41	55.50
200	208	Fans- Improve components - 20% savings	49.27	17.90	49.27
300	301	Pumps - O&M - 10% savings	48.29	24.44	48.29
400	429	Drives - Optimization process (M&T) - 20% savings	45.15	22.95	45.15
100	101	Compressed Air-O&M - 15% energy savings	41.48	13.02	41.48
100	108	Compressed Air- Sizing - 20% energy savings	37.97	18.02	37.97
550	553	Optimization Refrigeration - 25% savings	37.74	3.00	37.74
550	551	Efficient Refrigeration - Operations - 15% savings	35.08	22.41	35.08
820	824	Continuous Dimming, Fluorescent Fixtures	34.11	1.89	34.11
200	205	Fans - System Optimization - 25% savings	30.41	2.13	30.41
200	202	Fans - O&M - 10% savings	30.11	80.51	30.11
100	106	Compressed Air - System Optimization - 50% energy savings	28.88	4.03	28.88
550	554	Optimization Refrigeration - 50% savings	21.87	1.30	21.87
710	711	DX Tune Up/ Advanced Diagnostics	19.72	4.17	19.72
500	511	Heating - Optimization process (M&T) - 10% savings	18.21	8.41	18.21

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Top 20 Commercial Measures- Economic

Commercial Existing Top Twenty by Economic Potential (GWh)

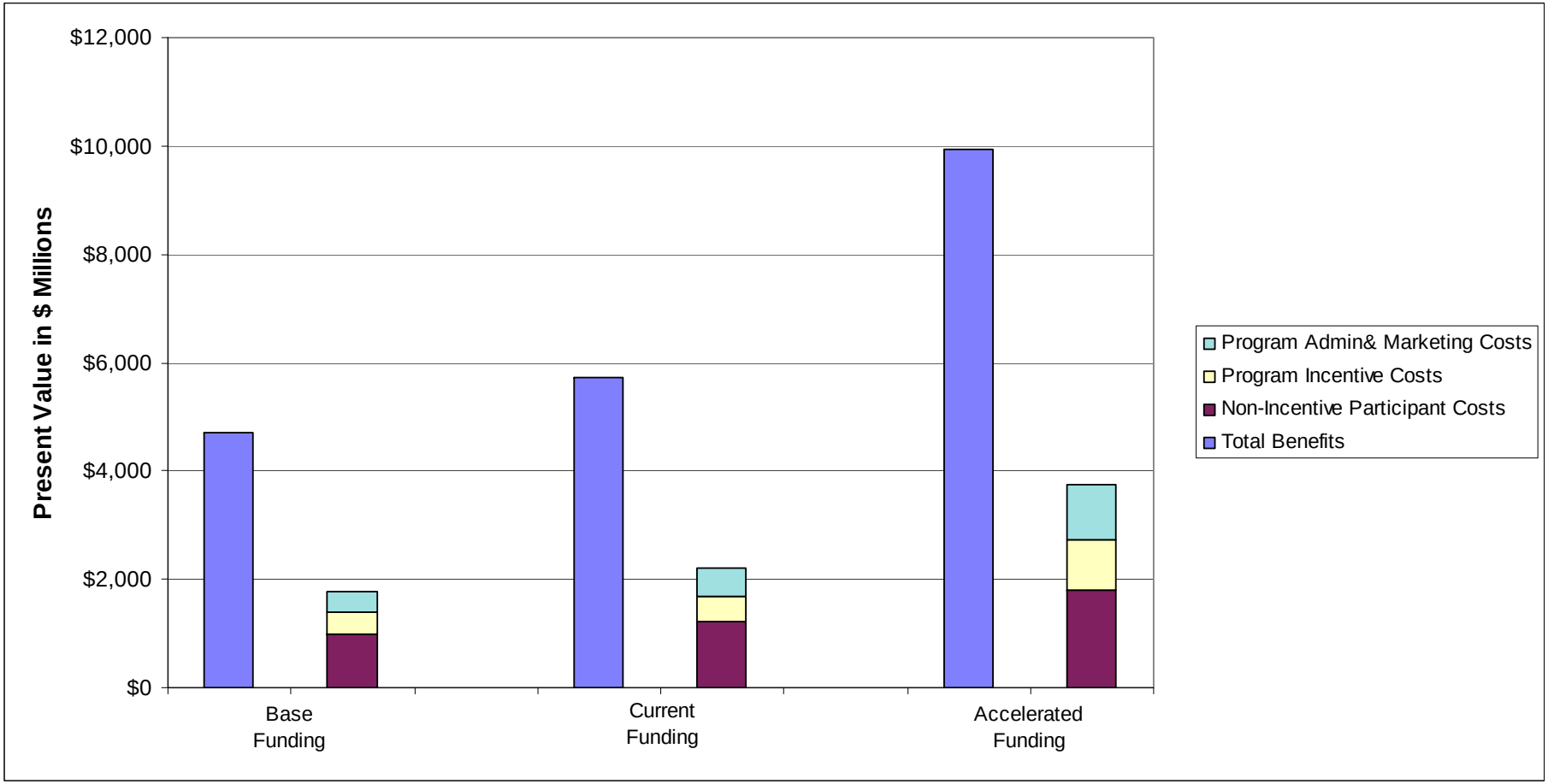
Base	Measure Number	Measure Name	Technical GWh	TRC	Economic GWh
610	611	Plug Loads Efficient Equipment & Practices	879.81	201.15	879.81
160	161	CFL Screw-in 18W	469.94	41.14	469.94
500	513	Refrigeration 30% More Efficient Design	263.14	24.48	263.14
220	221	High Pressure Sodium 250W Lamp	263.84	4.16	255.93
320	321	DX Tune Up/ Advanced Diagnostics	199.19	4.31	199.19
130	133	RET 2L4' Premium T8, 1EB	197.46	24.07	197.46
110	114	RET 4L4' Premium T8, 1EB	168.71	45.05	168.71
165	166	CFL Hardwired, Modular 18W	156.65	25.87	153.79
320	328	High Performance HVAC R/R - 30%	149.72	5.54	149.72
190	191	ROB 2L4' Premium T8, 1EB	144.04	13.58	143.29
110	115	RET 2L4' Premium T8, 1EB, Reflector	131.63	25.24	131.63
180	181	ROB 4L4' Premium T8, 1EB	129.91	16.07	129.87
320	322	DX Packaged System, EER=10.9, 10 tons	143.00	1.24	112.82
175	176	High Bay T5	99.16	15.28	97.99
180	182	Occupancy Sensor, 4L4' Fluorescent Fixtures	73.09	3.18	73.07
500	510	Demand Defrost Electric	72.71	73.05	72.71
500	508	Refrigeration Commissioning	67.91	4.52	67.91
500	512	Refrigeration 15% More Efficient Design	66.73	11.79	66.73
600	602	Data Center Best Practices	59.78	66.16	59.78
320	323	Window Film (Standard)	60.42	3.05	58.84

Top 20 CL&P Residential Measures- Economic

CL&P Residential Existing Top Twenty by Economic Potential (GWh)

Base	Measure Number	Measure Name	Building Type	Technical GWh	TRC	Economic GWh
210	211	CFL (18-Watt integral ballast), 3.0 hr/day	Single Family	614.30	17.55	614.30
210	211	CFL (18-Watt integral ballast), 3.0 hr/day	Multi-family	216.41	17.55	216.41
500	501	Heat Pump Water Heater (EF=2.5)	Single Family	214.43	1.33	214.43
600	602	Tier 3 CW (MEF=2.20)	Single Family	107.57	1.41	107.57
220	222	CFL Downlight	Single Family	83.75	4.35	83.75
100	102	15 SEER Split-System Air Conditioner	Single Family	79.75	1.37	79.75
500	501	Heat Pump Water Heater (EF=2.5)	Multi-family	79.11	1.03	79.11
100	118	2008 Energy Star Windows to Energy Star Phase-2 Windows	Single Family	73.57	1.35	73.57
180	181	Variable Speed Furnace Fan	Single Family	63.68	2.50	63.68
300	302	HE Refrigerator - CEE tier 2 (Top Mount)	Single Family	59.76	1.36	59.76
300	301	HE Refrigerator - Energy Star version of above (Top Mount)	Single Family	56.02	2.89	56.02
220	221	Downlights - LED Replacement	Single Family	53.08	2.20	53.08
190	193	Ceiling R-11 to R-38 Insulaton	Single Family	44.07	1.47	44.07
100	114	Duct Repair (0.32)	Single Family	41.74	6.04	41.74
910	912	Energy Star TV	Single Family	41.15	9.74	41.15
500	508	Water Heater Blanket	Single Family	36.54	10.14	36.54
230	231	ROB 2L4'T8, 1EB	Single Family	34.47	9.14	34.47
100	113	Proper Refrigerant Charging and Air Flow	Single Family	33.02	4.40	33.02
310	311	Refrigerator - Early Replacement Top Mount to 2008 Energy Star	Single Family	32.88	2.08	32.88
400	401	HE Freezer	Single Family	31.88	4.08	31.88

Overall Costs and Benefits by Scenario



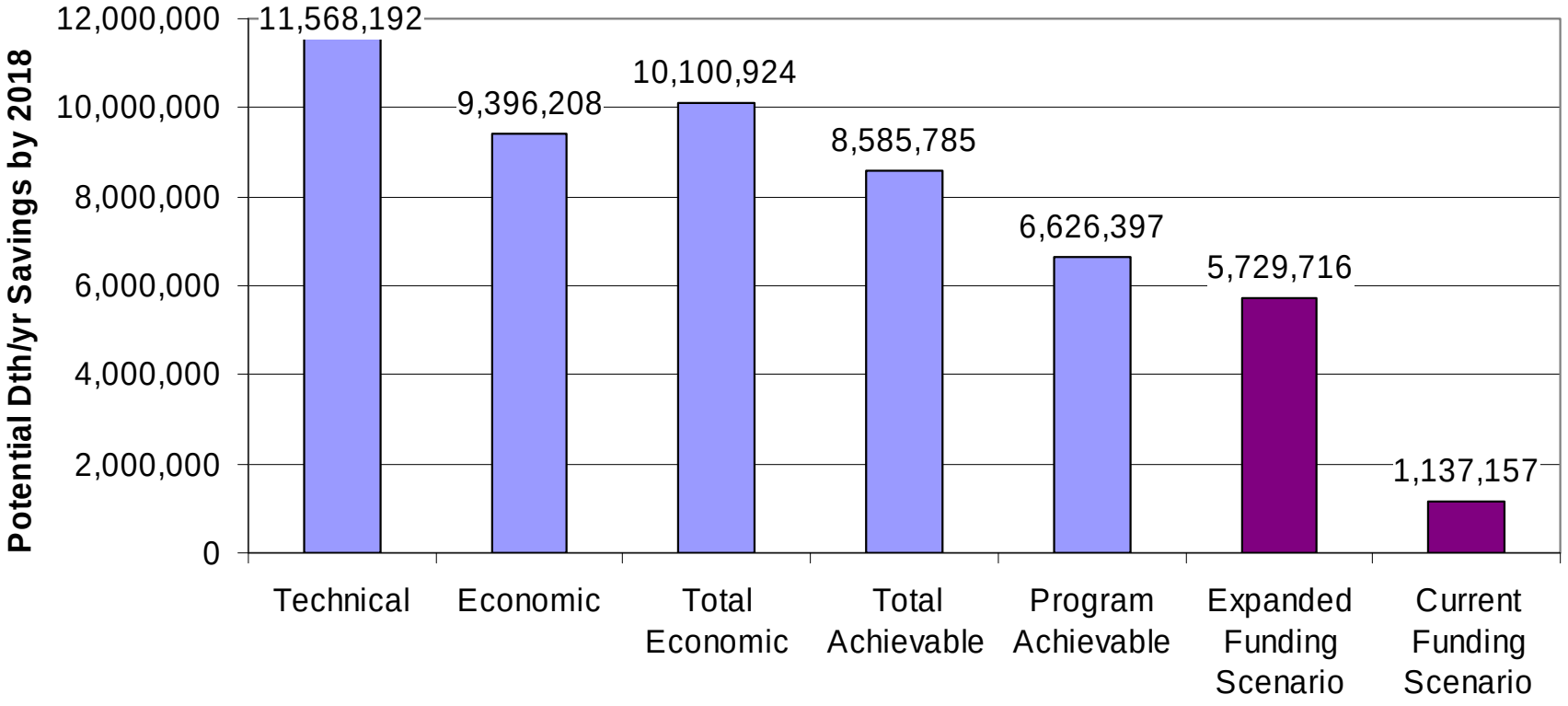
Gas Study Results
Commercial and Industrial (C&I)

Methodology

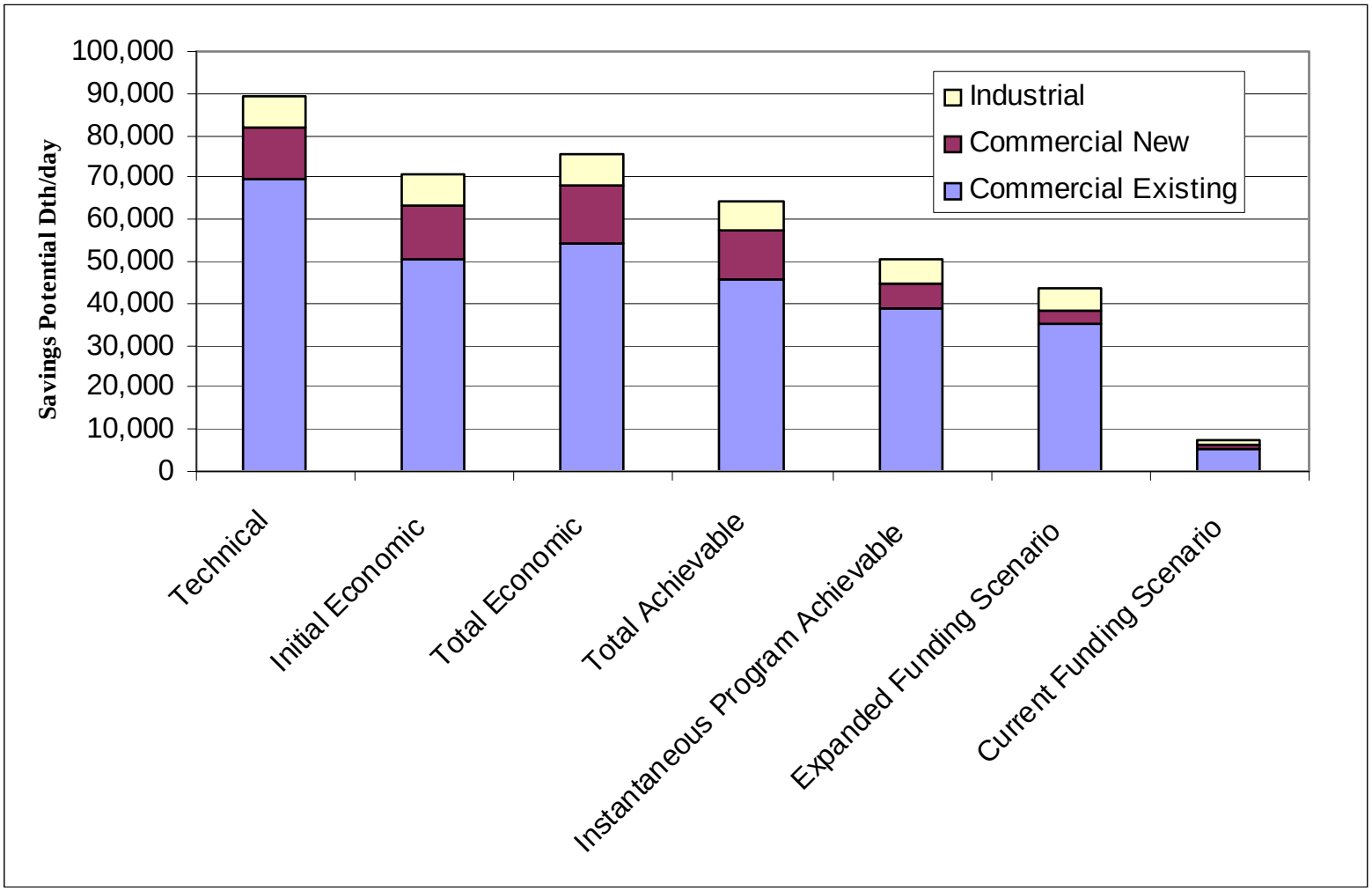
- KEMA evaluated 36 measures for existing commercial buildings, 31 for new commercial buildings and 37 for industrial buildings
- Data Collection
  - Measure data (costs, savings, saturation levels), building/market data (building stocks, end use saturations, and consumption levels), and economic data (avoided costs, inflation rates, discount rates)
- Selected Data Sources:

Commercial Building Energy Consumption Survey	Connecticut Department of Labor
California Commercial End Use Survey	Economic Census
California Database for Energy Efficiency Resources	various technology-specific internet sources

Energy Savings Summary



Peak Day Demand Savings Summary



Savings in 2018 (Potential savings weighted to reflect 2018 mix of new and existing load)

		Potential if All Floorspace that was Going to Convert Under the Scenario Converted Simultaneously					Cumulative Annual Net Savings in 2018 from 10 Years of Program Activities (2009-2018)	
Sector	**Base[a]**	**Technical Potential[b]**	**Initial Economic Potential[c]**	**Total Economic Potential[d]**	**Total Achievable Potential[e]**	**Program Achievable Potential[f]**	**Expanded Funding Scenario**	**Current Funding Scenario**
Total Energy Savings (Dth/yr)	39,717,492	11,568,192	9,396,208	10,100,924	8,585,785	6,626,397	5,729,716	1,137,157
Savings % of Base		*29%*	*24%*	*25%*	*22%*	*17%*	*14%*	*3%*
Savings % of Tech.		-	*81%*	*87%*	*74%*	*57%*	*50%*	*10%*
Savings % of Total Economic		-	-	-	*85%*	*66%*	*57%*	*11%*
Savings % of Program Achievable		-	-	-	-	-	*86%*	*17%*
Total Peak Day Demand Savings (Dth/Day)	297,194	89,264	70,483	75,769	64,403	50,653	43,704	7,512
Savings % of Base		*30%*	*24%*	*25%*	*22%*	*17%*	*15%*	*3%*
Savings % of Tech.		-	*79%*	*85%*	*72%*	*57%*	*49%*	*8%*
Savings % of Total Economic		-	-	-	*85%*	*67%*	*58%*	*10%*
Savings % of Program Achievable		-	-	-	-	-	*86%*	*15%*

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Top Measures by Economic Potential (Dth), by Sector

Commercial Existing Buildings

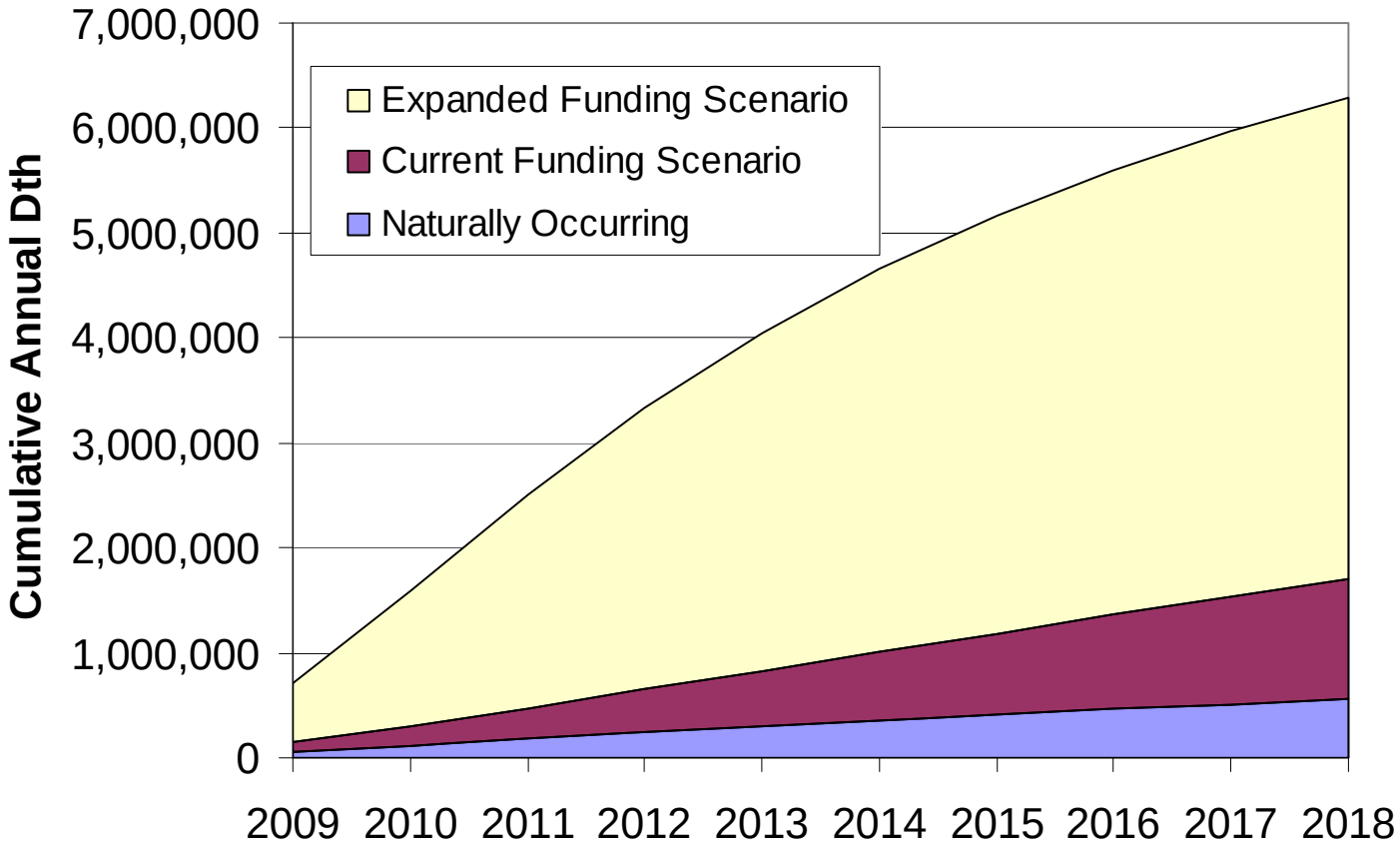
Measure Name	Economic Dth
High Efficiency Furnace/Boiler	1,805,382
Demand controlled ventilation	1,084,341
Installation of Energy Management Systems	699,276
Insulation (wall)	639,798
Energy Star Steamer	511,680
Condensing Water Heater	411,204
Clock / Programmable Thermostat	394,640
Tankless Water Heater	380,744
Energy Star Fryer	327,311
Heat Recovery from AC	263,458

Industrial

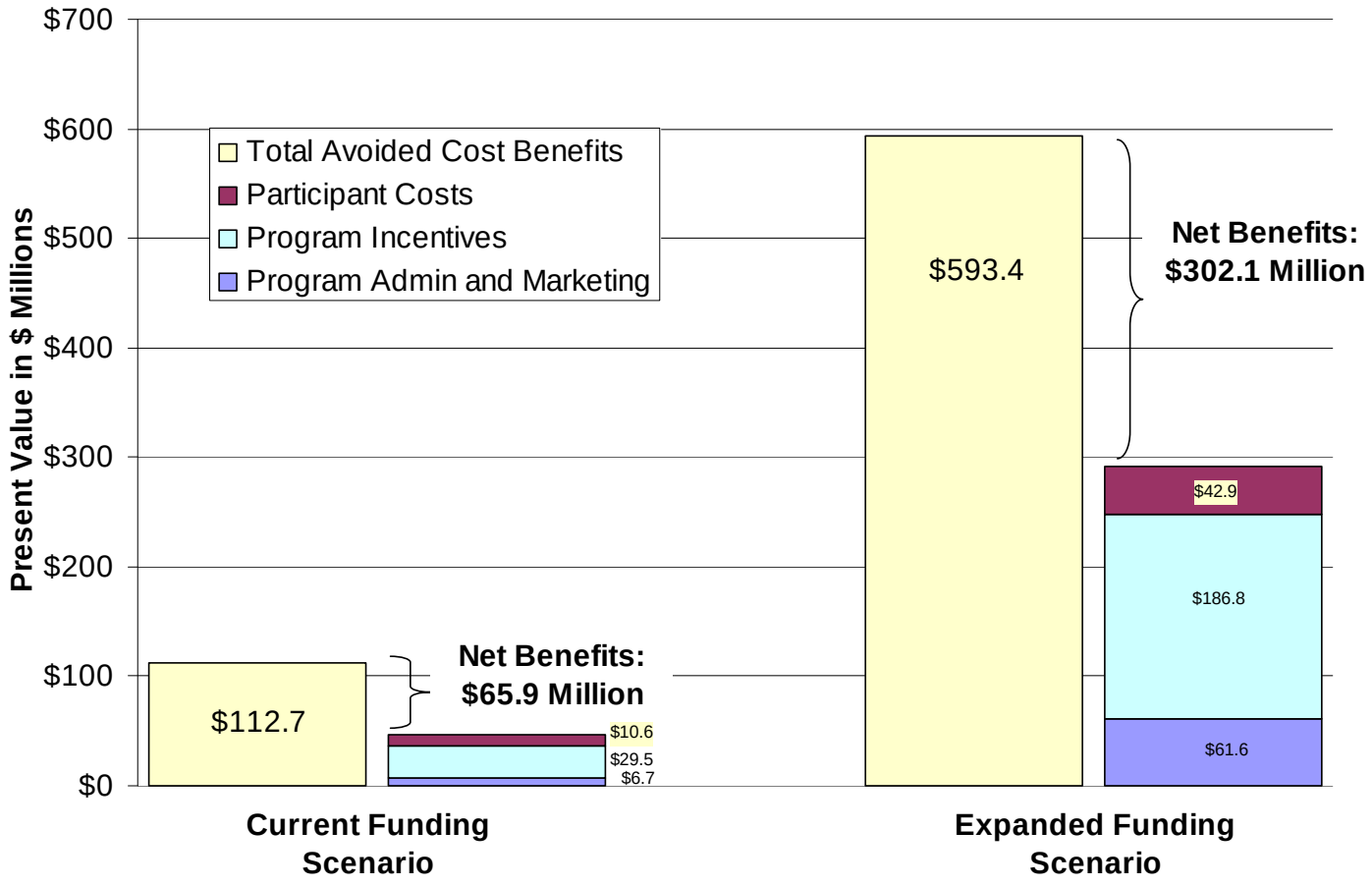
Measure Name	Economic Dth
Improved insulation	260,458
Efficient burners	252,666
Steam trap maintenance	181,322
Load control	141,641
Process Controls & Management	127,982

KEMA

Program Funding Scenario Savings: All Sectors



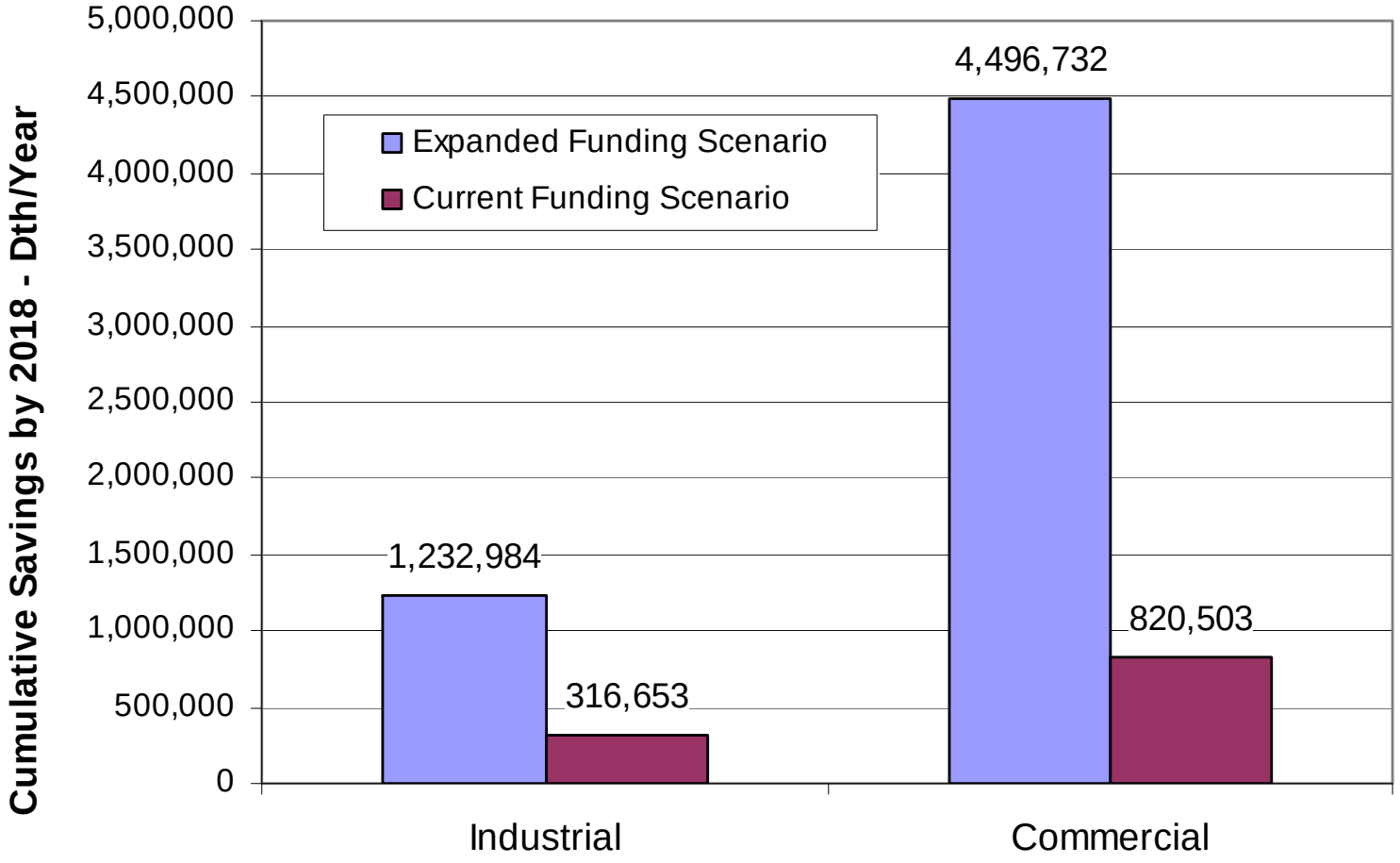
Benefits and Costs of Energy-Efficiency Savings – 2009-2018



Comparison Between 2009 Program Plan and Program Funding Scenario Results

	2009 Program Plan	Current Funding Scenario	Expanded Funding Scenario
2009 Annual Budget and Savings			
Total Budget	$3,540,000	$3,306,706	
Net Energy Savings (Dth)	66,393	86,977	
Net Energy Savings, % of Base Use	0.17%	0.22%	
Net Peak Day Demand Savings (Dth/day)	729	588	
Net Peak Day Demand Svgs, % of Base Demand	0.23%	0.19%	
$/net therm	$5.33	$3.80	
2009 Savings as a Multiple of Program Goals		1.3	
TRC	1.45	2.6	
10 Year Average Annual Budget and Savings			
Total Budget (2009$)		$4,493,541	$29,814,848
Net Energy Savings (Dth)		113,716	572,972
Net Energy Savings, % of Base Use		0.28%	1.4%
Net Peak Day Demand Savings (Dth/day)		789	4,589
Net Peak Day Demand Svgs, % of Base Demand		0.25%	1.5%
$/net therm		$3.95	$5.20
TRC		2.4	2.0
Cumulative Savings Due to Program Activity 2009-2018			
Net Energy Savings (Dth)		11,371,568	57,297,161
Net Energy Savings, % of Base Use		2.8%	14%
Net Peak Day Demand Savings (Dth/day)		7,512	43,704
Net Peak Day Demand Svgs, % of Base Demand		2.5%	15%

Scenario Results by Sector



Gas Price Sensitivity Analysis