Synapse
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The Sustainability and Costs of Increasing Efficiency Impacts: Evidence from Experience to Date

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Issues

- High Annual Electric Energy Savings through Energy Efficiency Programs
- Sustainability of High Energy Savings
- Conservation Supply Curve
- Trend in Cost of Saved Energy (CSE)

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High Annual Electric Energy Savings through Energy Efficiency Programs

Jurisdiction or Entity	Annual Savings (%)	Year(s)	Source
Interstate Power & Light (IPL) (MN)	3.0	2001	Garvey, E. 2007. "Minnesota's Demand Efficiency Program."
San Diego Gas & Electric (SDG&E) (CA)	2.1	2005	SDG&E 2006. Energy Efficiency Programs Annual Summary
Minnesota Power	1.9	2005	Garvey, E. 2007
Sacramento Municipal Utility District (SMUD) (CA)	1.9	1994	Data provided by SMUD
Vermont	1.8	2007	Efficiency Vermont 2008. 2007 Preliminary Results and Savings Estimate Report
Southern California Edison (SCE)	1.7	2005	SCE 2006. Energy Efficiency Annual Report
Western Mass. Electric Co. (MA)	1.6	1991	MA Dept. of Telecommunications & Energy (DTE) 2003. Electric Utility Energy Efficiency Database
Pacific Gas & Electric (PG&E) (CA)	1.5	2005	PG&E 2006. Energy Efficiency Programs Annual Summary
Massachusetts Electric Co.	1.3	2005	MECo 2006. 2005 Energy Efficiency Annual Report Revisions
Connecticut IOUs	1.3	2006	CT Energy Conservation Management Board (ECMB). 2007
Commonwealth Electric (MA)	1.2	1990	MA DTE 2003.
Cambridge Electric (MA)	1.1	2000	MA DTE 2003.
Seattle City Light (WA)	1.0	2001	Seattle City Light 2006. Energy Conservation Accomplishments: 1977-2005
Eastern Edison (MA)	1.0	1994, 1998	MA DTE 2003.

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Examples of High Energy Savings

	Mass. Electric	SMUD	W. Mass. Electric
1991	1.00%	0.70%	1.60%
1992	0.70%	1.30%	1.00%
1993	0.70%	1.10%	1.30%
1994	1.00%	1.90%	0.80%
1995	1.00%	1.60%	0.70%
1996	0.90%	0.90%	0.80%
1997	1.00%	0.40%	1.00%
1998	0.80%	0.40%	0.80%
1999	0.90%	0.30%	0.70%
2000	0.70%	0.30%	1.00%
2001	0.80%	0.70%	0.90%

	CT IOUs	Efficiency Vermont	IPL	SDG&E
2000	0.90%	0.40%		0.80%
2001	1.10%	0.70%	2.40%	1.10%
2002	0.90%	0.80%	2.50%	1.10%
2003	0.40%	1.00%	2.50%	0.70%
2004	1.00%	0.90%	2.50%	1.20%
2005	1.10%	1.00%	2.30%	2.00%
2006		1.00%	2.90%	
2007		1.80%		

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Cost of Saved Energy (CSE)

- Levelized CSE: The present value of the total cost of energy savings over the measure economic lives, converted to equal annual payments per kWh savings.
- Levelized CSE = Measure Costs x CRF / First Year kWh Savings
  - Capital Recovery Factor (CRF) = $i (1 + i)^n /\{(1 + i)^n – 1\}$
  - i = real discount rate
  - n = useful measure life (years)

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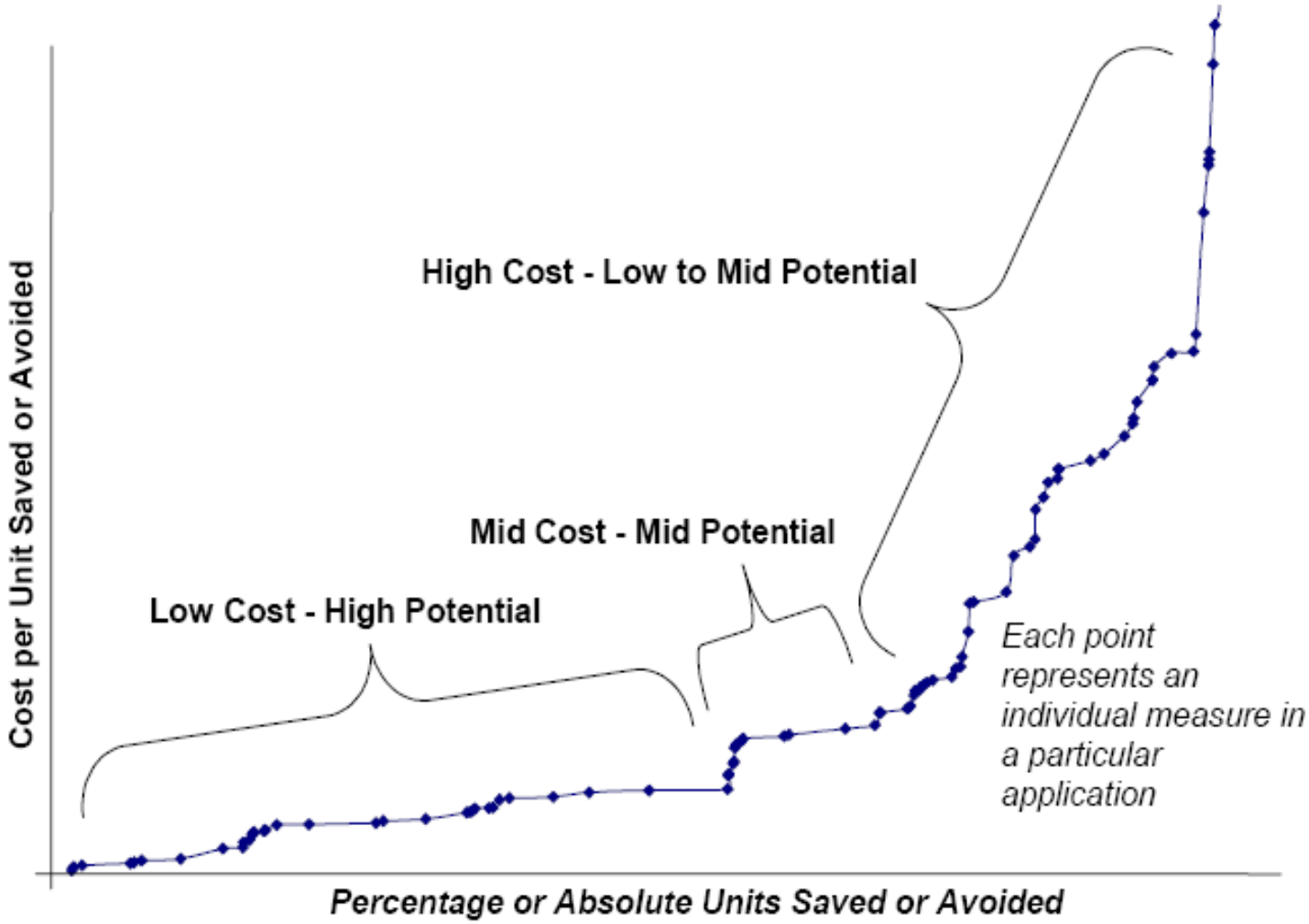
Conservation Supply Curve



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Limitting Factors

- Includes only demonstrated and currently well-understood measures.
- Program and measure cost reductions are not considered
- Costs associated with marketing, administration, and M&V are not included.
- Actual program design is often a portfolio of various measures and does not follow the CSC.

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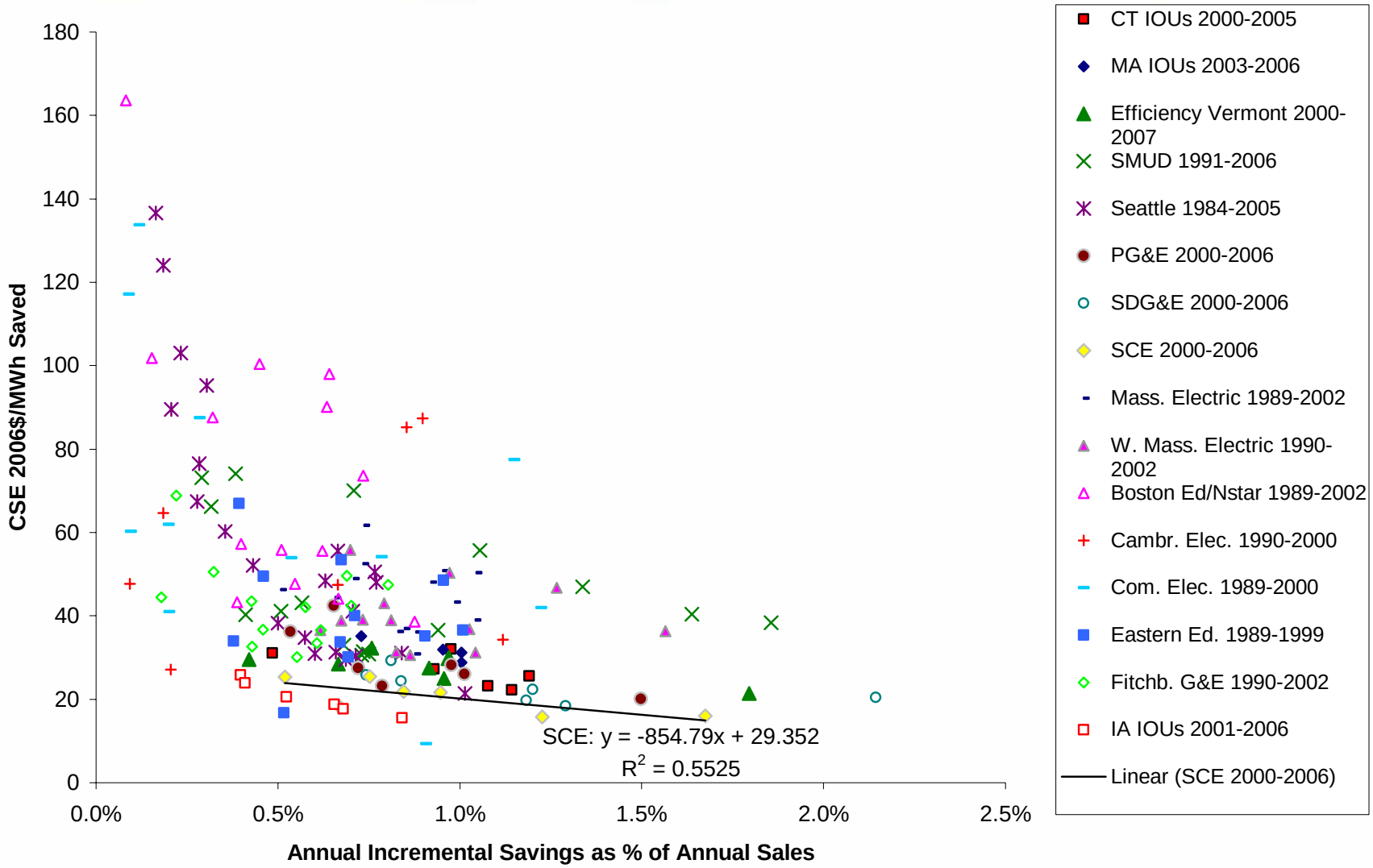
Utility Cost of Saved Energy (2006$/MWh) vs. Annual Incremental Savings as % of Sales



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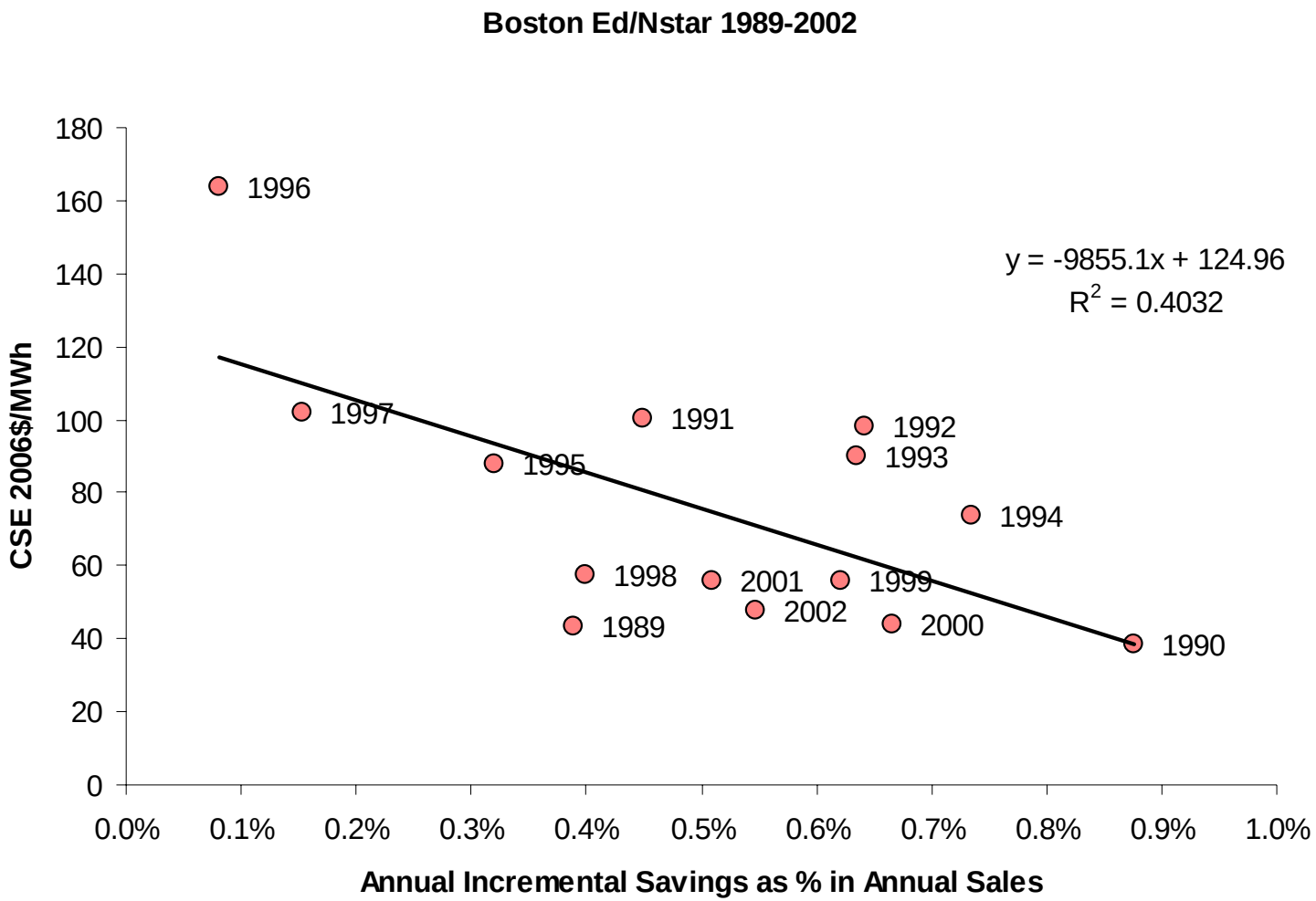
Example- Boston Edison/NStar



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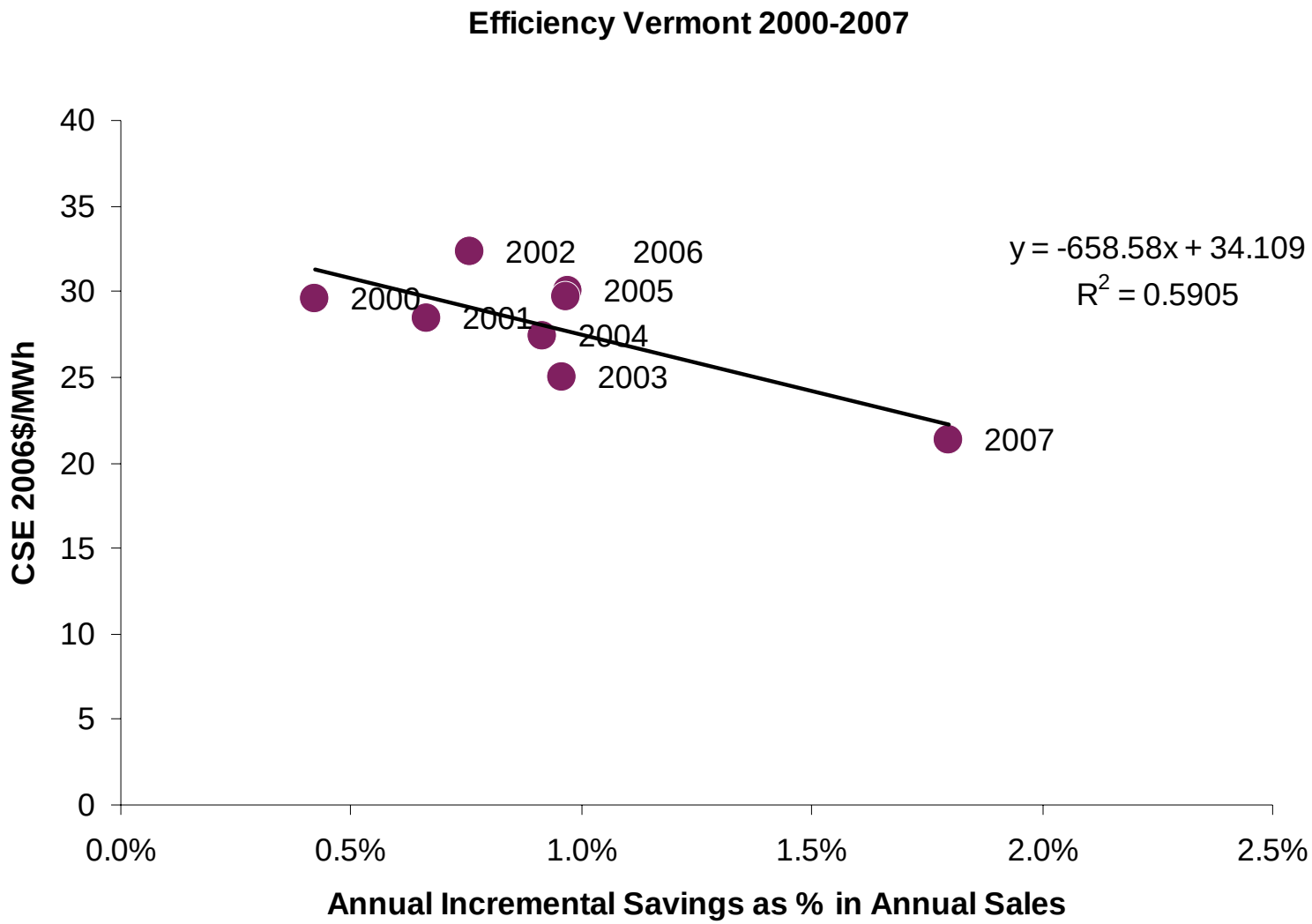
Example- Efficiency Vermont



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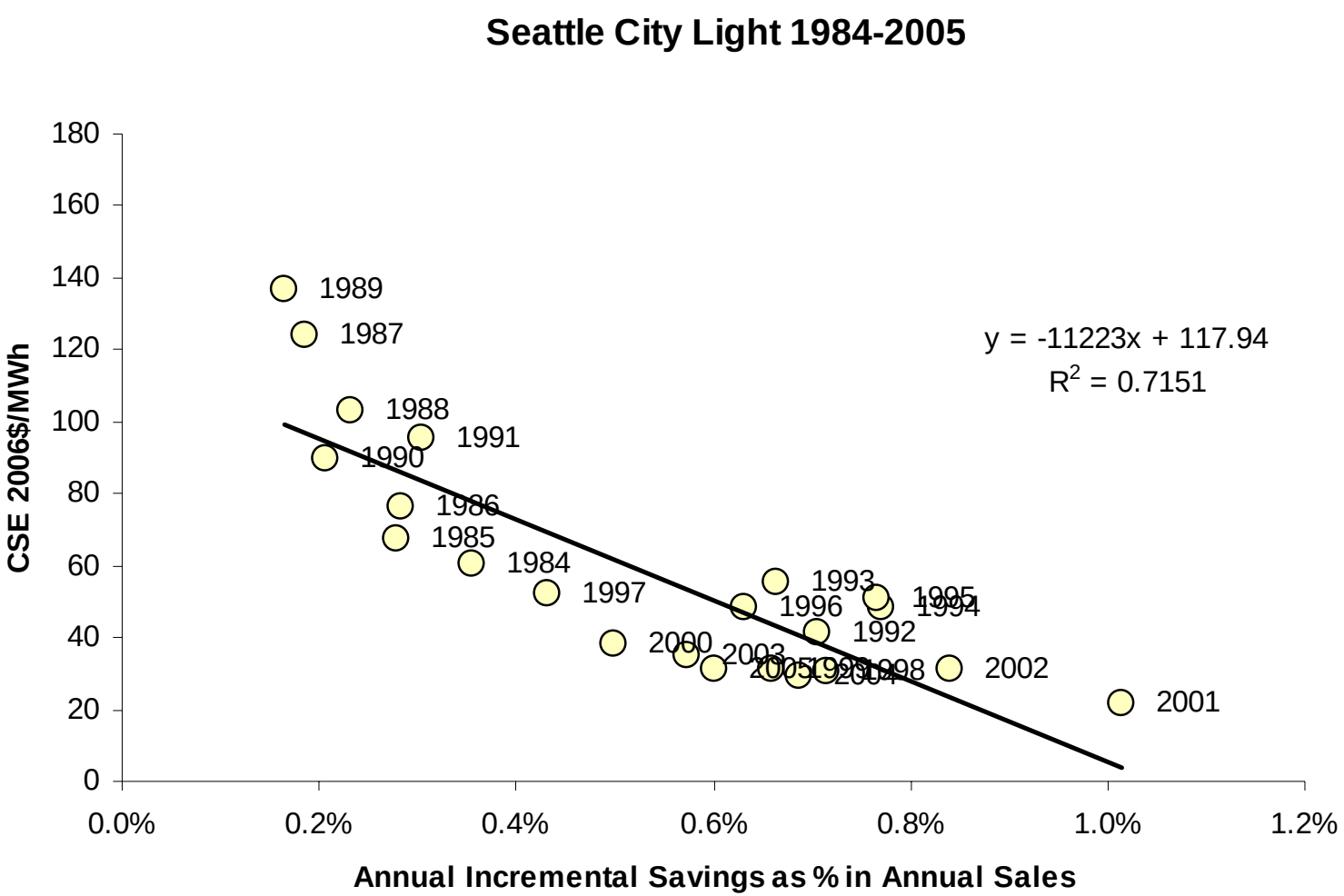
Example- Seattle City Light



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Utility Cost of Saved Energy (2006$/MWh) vs. Annual Incremental Savings as % of Sales

Data	Coefficient	R-square
CT IOUs 2000-2005	-1073	0.462
MA IOUs 2003-2006	-1798	0.834
Efficiency Vermont 2000-2007	-659	0.591
SMUD 1991 - 2006	-1257	0.136
Seattle 1984 - 2006	-11223	0.715
PG&E 2000-2006	-1747	0.526
SDG&E 2000-2006	-506	0.400
SCE 2000-2006	-771	0.553
Mass. Electric 1989-2002	-1185	0.050
W. Mass. Electric 1990-2002	-220	0.006
Boston Ed/Nstar 1989-2002	-9855	0.403
Cambr. Elec. 1990-2000	-48857	0.271
Com. Elec. 1989-2000	-8189	0.213
Eastern Ed. 1989-1999	-858	0.020
Fitchb. G&E 1990-2002	-1903	0.125
Iowa IOUs 2001-2006	-2189	0.943

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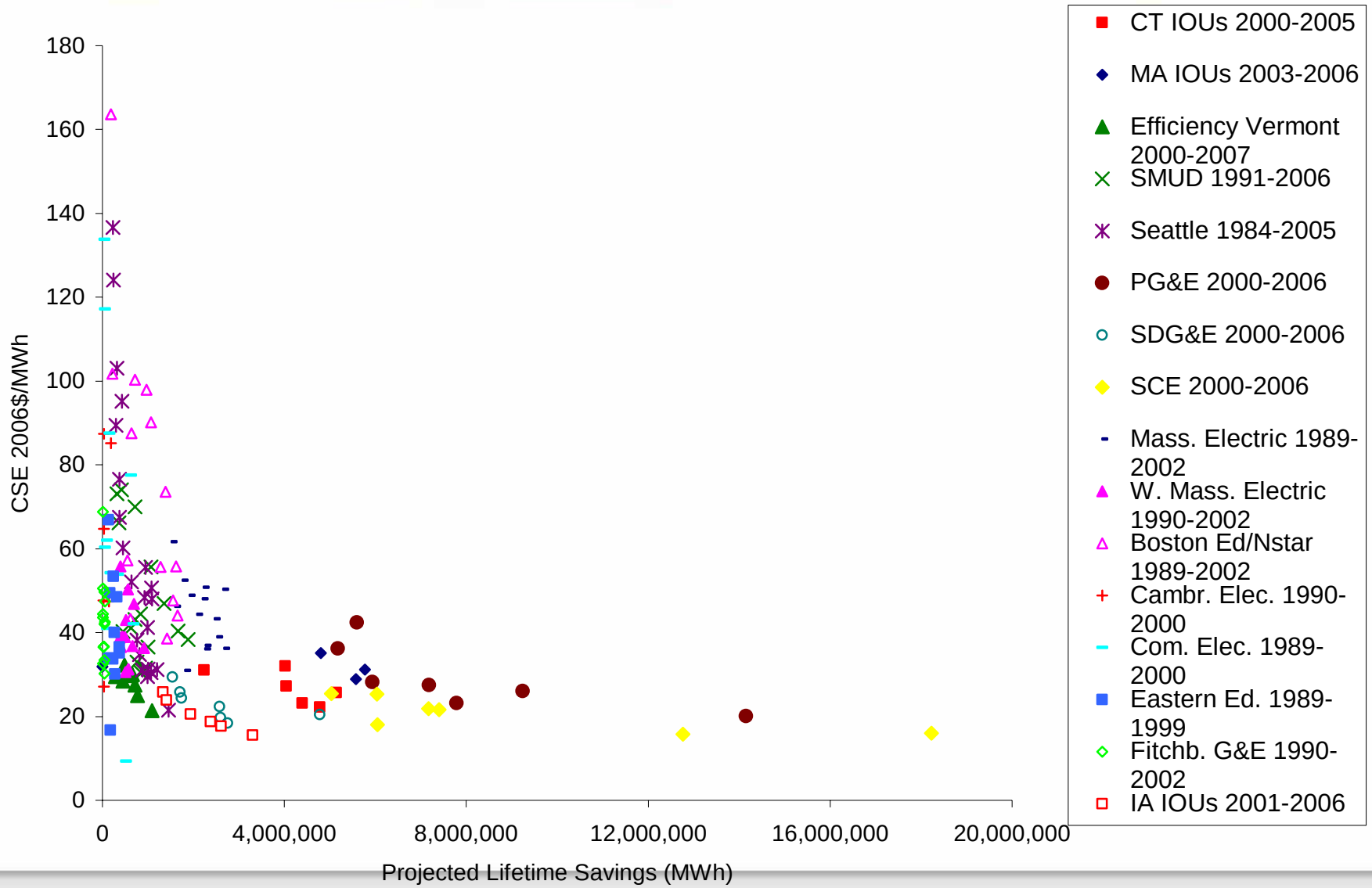
Utility Cost of Saved Energy (2006$/MWh) vs. Projected Lifetime Savings



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Utility Cost of Saved Energy (2006$/MWh) vs. Projected Lifetime Savings

Data	Coefficient	R-square
CT IOUs 2000-2005	-2.695E-06	0.457
MA IOUs 2003-2006	-4.950E-06	0.676
Efficiency Vermont 2000-2007	-1.135E-05	0.658
SMUD 1991 - 2006	-1.590E-05	0.207
Seattle 1984 - 2006	-7.680E-05	0.731
PG&E 2000-2006	-1.841E-06	0.552
SDG&E 2000-2006	-2.249E-06	0.420
SCE 2000-2006	-6.484E-07	0.591
Mass. Electric 1989-2002	-9.022E-06	0.168
W. Mass. Electric 1990-2002	-8.284E-06	0.026
Boston Ed/Nstar 1989-2002	-4.542E-05	0.454
Cambr. Elec. 1990-2000	-1.747E-03	0.183
Com. Elec. 1989-2000	-1.390E-04	0.186
Eastern Ed. 1989-1999	-2.854E-05	0.034
Fitchb. G&E 1990-2002	-1.760E-04	0.078
Iowa IOUs 2001-2006	-5.021E-06	0.948

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Possible Reasons for Cost Variation

(1) economies of scale are at work (e.g., allocating marketing and administration costs over more EE savings, achieving lower unit costs for program measures);

(2) economies of scope are at work (e.g., exploiting synergies among different measures);

(3) administrators become smarter and more organized in designing and developing EE programs (e.g., less incentive to get the same level of savings); or

(4) administrators have more credibility or more resources available for quality program design and development, etc.

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Key Finding

Among all of the datasets that we have collected, all of the slope coefficients of the linear trend lines are negative. This strongly suggests that per-unit cost of energy efficiency (EE) decreases as the amount of EE savings increases. It is important to emphasize that this finding contradicts the generally accepted theory that costs of EE increase when EE savings amounts increase.

The fact that the coefficient is negative in every case is particularly striking. While there exists a possibility that unit costs might begin to increase at much higher levels of EE program savings, this evidence suggests that current program savings levels have not yet approached any such point.

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Further Research Needs

- Adding data for additional utilities and regions to the analysis.
- Investigation of CSE by type of programs or sector (e.g. residential versus non-residential).
- Explicit analysis of the share of administrative and marketing costs to total program costs as a function of program impact, to test one of the hypotheses about economies of scale.
- And many more…

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