report

Extended ECM Tables November 2015

Retrofitting Affordability

be ex

building energy exchange

Report Partners:

BRIGHT POWER

sustainable energy partnerships

Table 13: ECMs Organized by Greatest Energy Savings by Segment: This table compares the cost and payback of all of the ECMs in each segment, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
All Electric							
Replace Windows	500	36%	$2.85	$$$$	$3,453.31	$$$$	11.0
Install Low-Flow Aerators	260	45%	0.32	$$$	$392.02	$$$	3.0
Upgrade DHW Boiler	130	36%	0.22	$$	$269.87	$$$	9.2
Motors – Install VFDs	120	45%	0.06	$$	$69.52	$$	2.9
Upgrade to LED	80	164%	0.06	$$	$67.92	$$	2.5
Process and Plug Loads	60	45%	0.13	$$	$153.26	$$$	5.7
Install Occupancy Sensors	30	36%	0.12	$$	$142.60	$$$	8.9
Upgrade to Fluorescent	30	55%	0.97	$$$	$1,170.30	$$$$	10.1
All District Steam							
Replace with LED	210	20%	$0.01	$	$10.61	$	3.8
Other – Other	160	14%	$0.14	$$	$189.58	$$$	6.0
Install or Upgrade EMS/BMS	130	10%	$0.14	$$	$185.05	$$$	0.8
Sealing - Door	70	10%	$0.02	$	$27.30	$$	1.4
Install Exhaust Fan Timers	30	8%	$0.01	$	$15.57	$	0.9
Replace Chiller	30	8%	$2.26	$$$$	$3,084.09	$$$$	10.9
Upgrade to Fluorescent	20	39%	$0.08	$$	$112.12	$$$	4.5
Install Occupancy Sensors	20	16%	$0.02	$	$25.11	$$	4.6
Upgrade to LED	10	102%	$0.04	$	$48.40	$$	2.2
Motors – Install VFDs	10	53%	$0.07	$$	$93.68	$$	6.0
Insulate Pipes	10	35%	$0.02	$	$24.37	$$	2.3
Install Low-Flow Aerators	-	8%	$0.10	$$	$142.59	$$$	1.7
Cooling System - Other	-	14%	$0.13	$$	$172.17	$$$	25.7
Lighting – Other	-	16%	$0.05	$$	$72.13	$$	3.3
Post-war Gas Low							
Separate DHW from Heating	1000	44%	$0.30	$$$	$301.72	$$$	6.7
Install or Upgrade EMS/BMS	630	22%	$0.26	$$$	$260.29	$$$	3.8
Install Low-Flow Aerators	500	29%	$0.08	$$	$79.19	$$	3.0
Upgrade Burner	390	25%	$0.25	$$	$247.39	$$$	6.7
Replace Boiler	240	4%	$0.71	$$$	$705.63	$$$$	20.2
Increase Insulation - Roof	190	25%	$0.63	$$$	$625.03	$$$$	66.1
Add Window Films	180	11%	$0.77	$$$	$770.63	$$$$	19.0
Insulate Pipes	180	47%	$0.02	$	$19.53	$	2.2
Install /Upgrade Master Venting	150	8%	$0.07	$$	$72.59	$$	3.3
Upgrade Boiler	120	6%	$3.06	$$$$	$3,051.97	$$$$	46.1
Upgrade to LED	100	203%	$0.02	$	$17.10	$	3.1

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

Cost per Square Foot		Cost per Unit		Payback (years)	
$	< $0.05	$	< $20.00		0–3
$$	$0.05-$0.25	$$	$20.00-$100.00		3.1–5
$$$	$0.26-$1.00	$$$	$100.01-$500.00		5.1–10
$$$$	> $1.00	$$$$	> $500		10.1–100

Table 13 (continued): ECMs Organized by Greatest Energy Savings by Segment: This table compares the cost and payback of all of the ECMs in each segment, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Decrease DHW Temperature	100	13%	$0.00	$	$1.54	$	0.2
Replace Windows	90	8%	$1.44	$$$$	$1,436.52	$$$$	30.3
Install Low-Flow Showerheads	90	7%	$0.08	$$	$81.56	$$	3.6
Upgrade to Fluorescent	80	70%	$0.03	$	$32.04	$$	3.5
Install CAR Dampers	80	3%	$0.33	$$$	$324.63	$$$	15.8
Install Indoor Sensors	70	3%	$0.27	$$$	$272.26	$$$	2.1
Install Submetering	60	6%	$0.46	$$$	$456.41	$$$	2.2
Upgrade Exhaust Fans	60	3%	$1.21	$$$$	$1,208.29	$$$$	9.4
Install DHW Controls	60	8%	$0.02	$	$17.76	$	1.3
Sealing - Door	60	31%	$0.04	$	$37.90	$$	7.8
Envelope - Other	50	4%	$1.34	$$$$	$1,340.12	$$$$	13.6
Upgrade Exterior Lighting	40	42%	$0.03	$	$33.80	$$	4.3
Heating System - Other	40	10%	$0.02	$	$18.12	$	4.1
Install Occupancy Sensors	40	42%	$0.04	$	$39.81	$$	5.8
Install TRVs	30	3%	$0.31	$$$	$311.06	$$$	11.0
Clean & Tune Boiler/Furnace	30	3%	$0.02	$	$17.69	$	1.0
Domestic Hot Water - Other	30	5%	$0.06	$$	$58.18	$$	2.7
Sealing - Room AC	30	12%	$0.08	$$	$82.63	$$	13.5
Lighting - Other	30	43%	$0.04	$	$42.14	$$	5.3
Motors - Upgrade Motors	20	27%	$0.05	$$	$52.02	$$	8.3
Sealing - Windows	20	5%	$0.15	$$	$150.54	$$$	10.0
Change Set Points - Heating	20	5%	$0.01	$	$9.92	$	1.6
Install Solar/Photovoltaic	20	5%	$0.31	$$$	$305.71	$$$	6.3
Zone Control Upgrades	10	3%	$0.19	$$	$185.92	$$$	16.9
Install Bi-level Lighting	10	24%	$0.06	$$	$63.14	$$	10.8
Ventilation - Other	10	3%	$0.03	$	$29.79	$$	2.8
Sealing - Vertical Shafts	10	4%	$0.08	$$	$78.22	$$	12.5
Upgrade Exit Signs to LED	-	9%	$0.01	$	$13.35	$	2.9
Insulate Condensate Tank	-	3%	$0.00	$	$4.82	$	1.9
Insulate DHW Piping	-	3%	$0.00	$	$4.64	$	5.3
Install Demand Control Ventilation	-	4%	$0.08	$$	$83.97	$$	20.2
Replace Glazing and Frames	-	3%	$0.00	$	$4.73	$	23.3
Other - Other	-	5%	$0.33	$$$	$332.38	$$$	2.6
Post-war Gas Mid							
Heating System - Other	760	28%	$1.10	$$$$	$1,120.00	$$$$	3.7
Install or Upgrade EMS/BMS	190	9%	$0.26	$$$	$263.14	$$$	3.5
Separate DHW from Heating	190	17%	$0.60	$$$	$613.22	$$$$	10.5
Upgrade Boiler	180	12%	$1.28	$$$$	$1,305.43	$$$$	26.6
Upgrade Burner	160	9%	$0.45	$$$	$456.92	$$$	7.4
Other - Other	140	11%	$0.13	$$	$132.70	$$$	2.1

Legend

	Cost per Square Foot	Cost per Unit	Payback (years)
Domestic Hot Water			
Heating & Distribution	$ < $0.05	$ < $20.00	0–3
Ventilation & Cooling	$$ $0.05-$0.25	$$ $20.00-$100.00	3.1–5
Envelope	$$$ $0.26-$1.00	$$$ $100.01-$500.00	5.1–10
Lighting	$$$$ > $1.00	$$$$ > $500	10.1–100
Fuel Switching			
Other			

Table 13 (continued): ECMs Organized by Greatest Energy Savings by Segment: This table compares the cost and payback of the ECMs in each segment, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Post-war Gas Mid (continued)							
Install TRVs	130	9%	$0.36	$$$	$370.41	$$$	10.0
Replace Boiler	130	6%	$2.60	$$$$	$2,640.52	$$$$	45.4
Install Low-Flow Aerators	100	18%	$0.06	$$	$63.21	$$	4.8
Insulate Pipes	100	26%	$0.03	$	$ 27.67	$$	6.8
Ventilation - Other	100	11%	$0.21	$$	$216.56	$$$	5.9
Install Submetering	70	8%	$0.65	$$$	$662.81	$$$$	2.2
Lighting - Other	60	58%	$0.12	$$	$119.23	$$$	4.4
Upgrade to LED	60	72%	$0.06	$$	$63.06	$$	3.7
HVAC Controls and Sensors	50	8%	$0.10	$$	$98.56	$$	1.9
Change Set Points - Heating	50	6%	$0.02	$	$19.56	$	0.9
Process and Plug Loads - Other	50	8%	$0.87	$$$	$880.69	$$$$	9.1
Motors - Install VFDs	40	12%	$0.12	$$	$123.94	$$$	5.2
Upgrade to Fluorescent	30	43%	$0.07	$$	$73.29	$$	7.5
Install OccupancySensors	30	32%	$0.06	$$	$63.92	$$	3.2
Install Exhaust Fan Timers	20	6%	$0.01	$	$14.40	$	0.9
Increase Insulation - Roof	20	11%	$0.22	$$	$218.68	$$$	15.2
Sealing - Room AC	20	6%	$0.23	$$	$231.03	$$$	13.4
Install Bi-level Lighting	20	23%	$0.14	$$	$138.66	$$$	7.6
Sealing - Door	10	9%	$0.02	$	$24.19	$$	5.1
Replace Washing Machines	10	9%	$0.04	$	$41.04	$$	6.1
Motors - Upgrade Motors	10	29%	$0.07	$$	$71.93	$$	16.6
Upgrade Exterior Lighting	-	11%	$0.10	$$	$105.95	$$$	7.4
Upgrade Packaged Units	-	6%	$0.28	$$$	$283.20	$$$	76.6
Post-war Gas High							
Install or Upgrade EMS/BMS	650	15%	$0.33	$$$	$377.24	$$$	3.3
Separate DHW from Heating	350	26%	$0.29	$$$	$333.53	$$$	9.3
Other	160	22%	$0.09	$$	$98.97	$$	5.7
Install Low-Flow Aerators	140	19%	$0.07	$$	$75.85	$$	3.9
Insulate Pipes	140	30%	$0.03	$	$37.13	$$	3.6
Upgrade to LED	120	93%	$0.04	$	$44.72	$$	3.4
Upgrade DHW Boiler	110	19%	$0.35	$$$	$397.30	$$$	31.6
Upgrade to Fluorescent	20	41%	$0.01	$	$12.69	$	2.0
Install Occupancy Sensors	10	33%	$0.01	$	$11.30	$	2.9
Upgrade to Flourescent	-	19%	$0.00	$	$2.20	$	2.3

Legend

	Cost per Square Foot	Cost per Unit	Payback (years)
Domestic Hot Water			
Heating & Distribution	$ < $0.05	$ < $20.00	0–3
Ventilation & Cooling	$$ $0.05-$0.25	$$ $20.00-$100.00	3.1–5
Envelope	$$$ $0.26-$1.00	$$$ $100.01-$500.00	5.1–10
Lighting	$$$$ > $1.00	$$$$ > $500	10.1–100
Fuel Switching			
Other			

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Post-war Oil							
Separate DHW from Heating	570	24%	$0.60	$$$	$624.34	$$$$	6.5
Increase Insulation - Floor	570	41%	$1.44	$$$$	$1,494.79	$$$$	4.0
Increase Insulation - Roof	500	19%	$3.61	$$$$	$3,748.38	$$$$	22.4
Envelope - Other	420	19%	$0.19	$$	$202.13	$$$	1.9
Replace Windows	180	19%	$0.08	$$	$82.53	$$	2.0
Sealing - Door	170	9%	$0.38	$$$	$395.23	$$$	5.1
Sealing - Room AC	100	4%	$0.61	$$$	$635.27	$$$$	79.4
#2 Oil to Natural Gas	100	98%	$0.06	$$	$60.55	$$	3.8
#6 Oil or #4 Oil to Natural Gas	90	4%	$0.16	$$	$163.45	$$$	1.5
#6 Oil to Dual Fuel	90	4%	$5.57	$$$$	$5,776.04	$$$$	20.3
Clean & Tune Boiler/Furnace	80	33%	$0.02	$	$22.19	$$	2.4
Heating System - Other	70	4%	$0.83	$$$	$857.64	$$$$	8.6
Replace Boiler	70	7%	$0.58	$$$	$603.04	$$$$	8.6
Upgrade Boiler	60	10%	$0.02	$	$16.33	$	0.8
Upgrade Burner	60	9%	$0.11	$$	$114.43	$$$	2.0
Change Set Points - Heating	60	10%	$0.02	$	$22.05	$$	0.9
Install Indoor Sensors	60	4%	$0.22	$$	$224.65	$$$	3.5
Install or Upgrade EMS/BMS	50	7%	$0.03	$	$29.22	$$	4.2
Install TRVs	40	3%	$0.01	$	$7.67	$	0.2
HVAC Controls and Sensors	40	6%	$0.32	$$$	$336.12	$$$	9.8
Install Bi-level Lighting	30	3%	$0.27	$$$	$281.21	$$$	9.3
Install Occupancy Sensors	30	4%	$0.19	$$	$194.32	$$$	5.7
Lighting - Other	30	5%	$1.99	$$$$	$2,064.35	$$$$	3.3
Replace with LED	30	4%	$0.01	$	$12.46	$	0.9
Upgrade Exit Signs to LED	30	25%	$0.08	$$	$82.96	$$	4.5
Upgrade Exterior Lighting	20	3%	$1.04	$$$$	$1,080.46	$$$$	4.2
Upgrade to Fluorescent	20	4%	$1.39	$$$$	$1,446.91	$$$$	5.6
Upgrade to LED	20	31%	$0.05	$	$50.85	$$	4.0
Motors - Install VFDs	10	4%	$0.05	$$	$55.64	$$	7.2
Motors - Remove Motors	10	5%	$0.09	$$	$90.88	$$	5.2
Motors - Upgrade Motors	10	13%	$0.02	$	$18.56	$	4.8
Install Solar/Photovoltaic	10	4%	$2.36	$$$$	$2,451.98	$$$$	4.2
Other - Other	10	14%	$0.06	$$	$59.47	$$	4.0
Replace Washing Machines	10	4%	$0.17	$$	$179.73	$$$	4.7
Install Exhaust Fan Timers	10	8%	$0.17	$$	$176.37	$$$	7.1
Ventilation - Other	10	3%	$0.14	$$	$144.31	$$$	18.1
Upgrade Exhaust Fans	10	4%	$0.01	$	$13.63	$	2.8
Install Low-Flow Aerators	-	8%	$0.03	$	$30.04	$$	7.2

Legend

		Cost per Square Foot		Cost per Unit		Payback (years)
Domestic Hot Water		$	< $0.05	$	< $20.00	0–3
Heating & Distribution		$$	$0.05-$0.25	$$	$20.00-$100.00	3.1–5
Ventilation & Cooling		$$$	$0.26-$1.00	$$$	$100.01-$500.00	5.1–10
Envelope		$$$$	> $1.00	$$$$	> $500	10.1–100
Lighting						
Fuel Switching						
Other						

Table 13 (continued): ECMs Organized by Greatest Energy Savings by Segment: This table compares the cost and payback of the five ECMs with the greatest potential energy savings in each segment.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Post-war Oil (continued)							
Distribution System - Other	-	5%	$0.01	$	$9.91	$	3.9
Insulate Pipes	-	4%	$0.06	$$	$63.22	$$	8.9
Install DHW Controls	-	3%	$0.02	$	$16.53	$	3.3
Domestic Hot Water - Other	-	4%	$0.02	$	$20.51	$$	8.9
Install Low-Flow Showerheads	-	4%	$0.03	$	$34.15	$$	3.8
Insulate DHW Piping	-	10%	$0.04	$	$36.91	$$	14.4
Replace Packaged Units	-	3%	$0.12	$$	$127.72	$$$	19.9
Pre-war Gas Low							
Separate DHW from Heating	340	33%	$0.48	$$$	$500.14	$$$$	11.7
Install or Upgrade EMS/BMS	320	15%	$0.23	$$	$240.59	$$$	2.3
Install Low-Flow Showerheads	210	6%	$0.04	$	$42.71	$$	3.1
Install Low-Flow Aerators	190	27%	$0.06	$$	$64.91	$$	3.0
Add Window Films	190	18%	$0.83	$$$	$ 876.65	$$$$	22.1
Insulate Pipes	180	52%	$0.04	$	$41.82	$$	3.0
Replace Windows	150	15%	$2.08	$$$$	$2,187.29	$$$$	38.8
Increase Insulation - Roof	110	20%	1.17	$$$$	1,231.94	$$$$	84.9
Replace Boiler	100	$6%	1.78	$$$$	$1,870.76	$$$$	21.9
Install DHW Controls	70	15%	$0.02	$	$16.49	$	1.0
Upgrade to LED	60	102%	$0.03	$	$28.22	$$	3.5
Install Indoor Sensors	60	4%	$0.19	$$	$201.35	$$$	2.6
Install TRVs	40	5%	$0.39	$$$	$413.89	$$$	10.6
Clean & Tune Boiler/Furnace	40	8%	$0.10	$$	$104.58	$$$	3.1
Sealing - Door	30	23%	$0.04	$	$43.53	$$	10.8
Upgrade Burner	30	4%	$0.26	$$$	$272.98	$$$	5.3
Decrease DHW Temperature	30	6%	$0.01	$	$7.73	$	0.4
Upgrade to Fluorescent	30	42%	$0.07	$$	$70.16	$$	4.7
Install Occupancy Sensors	10	27%	$0.06	$$	$65.88	$$	6.7
Lighting - Other	10	29%	$0.04	$	$46.31	$$	4.5
Domestic Hot Water - Other	10	4%	$0.44	$$$	$465.26	$$$	9.4
Change Set Points - Heating	10	3%	$0.00	$	-	$	0.0
Sealing - Windows	10	6%	$0.23	$$	$244.62	$$$	6.3
Heating System - Other	10	6%	$0.01	$	$14.34	$	5.5
Install Photocell Control	10	6%	$0.04	$	$41.61	$$	4.9
Upgrade Exterior Lighting	-	16%	$0.03	$	$34.46	$$	5.0
Insulate DHW Piping	-	7%	$0.01	$	$11.95	$	4.2
Install Bi-level Lighting	-	5%	$0.06	$$	$65.00	$$	8.2
Motors - Upgrade Motors	-	7%	$0.05	$	$50.59	$$	10.6

Legend

		Cost per Square Foot	Cost per Unit	Payback (years)
Domestic Hot Water	$	< $0.05	< $20.00	0–3
Heating & Distribution	$$	$0.05-$0.25	$20.00-$100.00	3.1–5
Ventilation & Cooling	$$$	$0.26-$1.00	$100.01-$500.00	5.1–10
Envelope	$$$$	> $1.00	> $500	10.1–100
Lighting				
Fuel Switching				
Other				

Table 13 (continued): ECMs Organized by Greatest Energy Savings by Segment: This table compares the cost and payback of all of the ECMs in each segment, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Process and Plug Loads - Other	-	3%	$0.16	$$	$163.96	$$$	9.5
Repair Leaks	-	3%	$0.00	$	$3.08	$	0.7
Upgrade Exit Signs to LED	-	3%	$0.01	$	$15.68	$	3.5
Upgrade Exhaust Fans	-	3%	0.02	$	20.79	$$	5.5
Pre-war Gas Mid							
Install TRVs	60	19%	$0.38	$$$	$ 451.62	$$$	8.5
Separate DHW from Heating	60	19%	$0.60	$$$	$703.24	$$$$	14.5
Install Low-Flow Aerators	40	29%	$0.05	$	$53.94	$$	5.00
Motors – Install VFDs	30	19%	$0.18	$$	$210.14	$$$	3.9
Insulate Pipes	30	32%	$0.04	$	$41.45	$$	2.2
Lighting - Other	20	35%	$0.08	$$	$91.06	$$	3.6
Change Set Points - Heating	10	16%	$0.04	$	$52.44	$$	1.9
Upgrade to Fluorescent	10	16%	$0.15	$$	$178.87	$$$	4.7
Sealing - Door	10	13%	$0.04	$	$42.41	$$	5.4
Upgrade to LED	-	23%	$0.01	$	$16.40	$	2.2
Envelope - Other	-	13%	$0.01	$	14.96	$$	9.4
Pre-war Oil Low							
Install or Upgrade EMS/BMS	280	20%	$0.28	$$$	$298.03	$$$	1.8
Separate DHW from Heating	250	28%	$0.62	$$$	$662.64	$$$$	7.8
Replace Windows	190	18%	$3.03	$$$$	$3,245.20	$$$$	36.3
Install Low-Flow Aerators	120	28%	$0.06	$$	$61.81	$$	2.4
Install Indoor Sensors	110	9%	$0.37	$$$	$398.89	$$$	2.4
Insulate Pipes	100	53%	$0.04	$	$47.40	$$	3.8
Increase Insulation - Roof	100	20%	$1.11	$$$$	$1,186.97	$$$$	50.4
Add Window Films	80	14%	$0.99	$$$	$1,059.81	$$$$	16.3
#6 Oil or #4 Oil to Natural Gas	60	16%	$2.61	$$$$	$2,801.63	$$$$	4.6
Envelope - Other	60	7%	$1.07	$$$$	$1,142.83	$$$$	13.2
Install TRVs	50	4%	$0.44	$$$	$468.17	$$$	6.4
#6 Oil to Dual Fuel	40	12%	$3.40	$$$$	$3,640.87	$$$$	4.2
Heating System - Other	40	15%	$0.24	$$	$255.28	$$$	2.2
Install DHW Controls	40	11%	$0.03	$	$29.57	$$	1.9
Replace Boiler	30	4%	$2.17	$$$$	$2,327.93	$$$$	18.9
Upgrade to Fluorescent	20	59%	$0.16	$$	$171.53	$$$	4.4
Clean & Tune Boiler/Furnace	20	3%	$0.04	$	$45.81	$$	0.2
Upgrade to LED	20	69%	$0.03	$	$30.45	$$	3.3
#2 Oil to Natural Gas	20	7%	$2.61	$$$$	$2,796.93	$$$$	3.7

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

Cost per Square Foot		Cost per Unit		Payback (years)	
$	< $0.05	$	< $20.00		0–3
$$	$0.05-$0.25	$$	$20.00-$100.00		3.1–5
$$$	$0.26-$1.00	$$$	$100.01-$500.00		5.1–10
$$$$	> $1.00	$$$$	> $500		10.1–100

Table 13 (continued): ECMs Organized by Greatest Energy Savings by Segment: This table compares the cost and payback of all of the ECMs in each segment, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Pre-war Oil Low (continued)							
Decrease DHW Temperature	20	4%	$0.01	$	$12.18	$	9.4
Distribution System - Other	10	3%	$0.18	$$	$195.34	$$$	4.3
Sealing - Door	10	29%	$0.04	$	$37.52	$$	7.5
Domestic Hot Water - Other	10	3%	$0.11	$$	$114.33	$$$	4.4
Lighting - Other	10	25%	$0.05	$	$52.98	$$	3.8
Insulate DHW Piping	10	10%	$0.06	$$	$63.97	$$	7.2
Sealing - Room AC	-	6%	$0.05	$$	$57.36	$$	12.1
#6 Oil or #4 Oil to #2 Oil	-	4%	$0.20	$$	$214.87	$$$	1.6
Upgrade Exterior Lighting	-	18%	$0.02	$	$24.26	$$	3.1
Install Occupancy/Vacancy Sensors	-	10%	$0.05	$	$50.86	$$	8.0
Sealing - Windows	-	4%	$0.03	$	$35.00	$$	3.3
Ventilation - Other	-	4%	$0.02	$	$16.24	$	1.2
Install Solar/Photovoltaic	-	3%	$0.29	$$$	$308.72	$$$	6.4
Repair Leaks	-	4%	$0.01	$	$14.22	$	0.8
Other - Other	-	5%	$0.14	$$	$149.07	$$$	6.1
Install Photocell Control	-	7%	$0.05	$$	$58.89	$$	8.4
Replace Washing Machines	-	6%	$0.03	$	$35.54	$$	4.5
Exterior Door Replacement	-	3%	$0.03	$	$29.98	$$	6.3
Upgrade Exit Signs to LED	-	5%	$0.02	$	$16.13	$	2.8
Pre-war Oil Mid							
Separate DHW from Heating	260	38%	$0.55	$$$	$855.15	$$$$	9.1
#2 Oil to Natural Gas	200	8%	$2.19	$$$$	$3,428.19	$$$$	4.3
Install or Upgrade EMS/BMS	170	17%	$0.21	$$	$325.55	$$$	2.4
#6 Oil or #4 Oil to Natural Gas	110	36%	$2.05	$$$$	$3,205.49	$$$$	5.0
Install Low-Flow Aerators	110	32%	$0.07	$$	$106.83	$$$	2.1
Replace Boiler	100	8%	$2.92	$$$$	$4,567.05	$$$$	12.6
Install Indoor Sensors	90	12%	$0.17	$$	$260.40	$$$	2.7
Install TRVs	80	14%	$0.26	$$$	$408.22	$$$	5.1
Replace Windows	60	14%	$1.59	$$$$	$2,493.49	$$$$	40.8
Insulate Pipes	50	50%	$0.03	$	$42.15	$$	2.8
Upgrade to LED	50	60%	$0.06	$$	$87.30	$$	3.9
Add Window Films	40	7%	$0.69	$$$	$1,085.42	$$$$	15.2
Increase Insulation - Roof	40	7%	$0.57	$$$	$895.37	$$$$	32.8
HVAC Controls and Sensors - Other	30	8%	$0.14	$$	$221.13	$$$	5.0
Distribution System - Other	30	6%	$0.28	$$$	$441.63	$$$	4.4
Heating System - Other	30	21%	$0.11	$$	$170.38	$$$	6.9
#6 Oil to Dual Fuel	30	7%	$2.02	$$$$	$3,157.79	$$$$	4.7

Legend

	Cost per Square Foot	Cost per Unit	Payback (years)
Domestic Hot Water	$ < $0.05	$ < $20.00	0–3
Heating & Distribution	$$ $0.05-$0.25	$$ $20.00-$100.00	3.1–5
Ventilation & Cooling	$$$ $0.26-$1.00	$$$ $100.01-$500.00	5.1–10
Envelope	$$$$ > $1.00	$$$$ > $500	10.1–100
Lighting			
Fuel Switching			
Other			

Table 13 (continued): ECMs Organized by Greatest Energy Savings by Segment: This table compares the cost and payback of all of the ECMs in each segment, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Domestic Hot Water - Other	20	11%	$0.08	$$	$117.90	$$$	29.6
Upgrade to Fluorescent	20	45%	$0.06	$$	$89.88	$$	3.4
Sealing - Vertical Shafts	20	10%	$0.07	$$	$111.48	$$$	3.7
Lighting - Other	20	46%	$0.09	$$	$135.99	$$$	4.8
Sealing - Door	20	26%	$0.02	$	$32.95	$$	4.2
Change Set Points - Heating	20	10%	$0.02	$	$37.33	$$	1.9
Replace or Repair Steam Traps	20	5%	$0.16	$$	$247.83	$$$	5.8
Install DHW Controls	20	14%	$0.01	$	$20.24	$$	3.1
Clean & Tune Boiler/Furnace	10	7%	$0.09	$$	$134.47	$$$	1.5
Decrease DHW Temperature	10	6%	$0.00	$	$2.09	$	0.1
Envelope - Other	10	12%	$0.03	$	$46.00	$$	6.3
Install Occupancy Sensors	10	24%	$0.03	$	$41.60	$$	4.6
Increase Insulation - Wall	10	5%	$0.07	$$	$109.92	$$$	5.2
Motors - Install VFDs	10	5%	$0.10	$$	$163.48	$$$	8.1
Install Solar/Photovoltaic	-	5%	$0.19	$$	$291.59	$$$	10.7
Insulate DHW Piping	-	11%	$0.01	$	$10.73	$	2.4
Motors - Remove Motors	-	7%	$0.02	$	$29.95	$$	2.0
Insulate Condensate Tank	-	5%	$0.01	$	$12.42	$	3.5
Install Photocell Control	-	8%	$0.02	$	$31.05	$$	3.8
Motors - Upgrade Motors	-	7%	$0.04	$	$56.01	$$	16.4
Replace Washing Machines	-	10%	$0.02	$	$24.08	$$	10.7
Process and Plug Loads - Other	-	6%	$0.12	$$	$183.06	$$$	4.3
Delamp	-	6%	$0.01	$	$8.20	$	3.1
Replace with LED	-	11%	$0.01	$	$10.92	$	3.9
Upgrade Exterior Lighting	-	5%	$0.01	$	$11.03	$	1.9
Upgrade Exit Signs to LED	-	5%	$0.01	$	$9.28	$	2.0

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

	Cost per Square Foot	Cost per Unit	Payback (years)
$	< $0.05	< $20.00	0–3
$$	$0.05-$0.25	$20.00-$100.00	3.1–5
$$$	$0.26-$1.00	$100.01-$500.00	5.1–10
$$$$	> $1.00	> $500	10.1–100

Table 14: ECMs Organized by Greatest Energy Savings by Category: This table compares the cost and payback of the all of the ECMs in each category, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Domestic Hot Water							
Separate DHW from Heating	3010	36%	$0.38	$$$	$415	$$$	5.8
Install Low-Flow Aerators	1650	31%	$0.12	$$	$132	$$$	2.0
Install Low-Flow Showerheads	310	4%	$0.04	$	$44	$$	1.3
Upgrade DHW Boiler	240	1%	$0.42	$$$	$491	$$$	7.3
Install DHW Controls	240	11%	$0.02	$	$17	$	0.6
Decrease DHW Temperature	150	6%	$0.00	$	$3	$	0.1
Other	120	5%	$0.12	$$	$133	$$$	4.8
Insulate DHW Piping	30	7%	$0.03	$	$38	$$	2.3
Envelope							
Replace Windows	1490	17%	$3.63	$$$$	$4,017	$$$$	17.8
Increase insulation – Roof	560	20%	$0.72	$$$	$753	$$$$	18.2
Add Window Films	500	12%	$0.69	$$$	$732	$$$$	14.0
Other	190	6%	$0.51	$$$	$593	$$$$	13.2
Sealing – Door	160	30%	$0.02	$	$27	$$	4.9
Sealing – Room AC	80	6%	$0.09	$$	$88	$$	8.6
Increase insulation – Floor	30	1%	$0.25	$$$	$261	$$$	3.3
Sealing – Vertical Shafts	30	2%	$0.05	$$	$65	$$	4.3
Sealing – Windows	30	4%	$0.11	$$	$112	$$$	6.7
Increase insulation – Wall	-	1%	$0.09	$$	$137	$$$	5.0
Exterior Door Replacement	-	1%	$0.02	$	$20	$$	6.8
Replace Glazing and Frames	-	1%	$0.00	$	$2	$	8.5
Fuel Switching							
#6 Oil or #4 Oil to Natural Gas	740	65%	$1.59	$$$$	$1,830	$$$$	3.8
#2 Oil to Natural Gas	230	13%	$2.13	$$$$	$2,539	$$$$	3.4
#6 to Dual Fuel	100	18%	$2.42	$$$$	$2,778	$$$$	3.5
#6 Oil or #4 Oil to #2 Oil	-	4%	$0.20	$$	$216	$$$	3.1
Heating & Distribution							
Install or Upgrade EMS/BMS	2780	15%	$0.19	$$	$205	$$$	1.7
Heating System – Other	940	10%	$0.40	$$$	$428	$$$	3.6
Insulate Pipes	890	38%	$0.02	$	$26	$$	2.0
Replace Boiler	690	4%	$1.97	$$$$	$2,148	$$$$	12.8

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching

Other

Cost per Square Foot

$	< $0.05
$$	$0.05-$0.25
$$$	$0.26-$1.00
$$$$	> $1.00

Cost per Unit

$	< $20.00
$$	$20.00-$100.00
$$$	$100.01-$500.00
$$$$	> $500

Payback (years)

■	0–3
■	3.1–5
■	5.1–10
■	10.1–100

Table 14 (continued): ECMs Organized by Greatest Energy Savings by Category: This table compares the cost and payback of the all of the ECMs in each category, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost Per SF		Cost Per unit		Payback (years)
Upgrade Burner	610	6%	$0.29	$$$	$292	$$$	5.3
Upgrade Boiler	310	2%	$1.00	$$$$	$1017	$$$$	15.6
Change Set Points /Setbacks	170	4%	$0.02	$	$17	$	0.9
Install / Upgrade Master Venting	150	1%	$0.08	$$	$76	$$	3.0
Clean & Tune Boiler/Furnace	140	3%	$0.05	$	$53	$$	1.6
Distribution System – Other	130	2%	$0.19	$$	$222	$$$	3.5
Replace or repair Steam Traps	20	0%	$0.17	$$	$263	$$$	4.3
Insulate Condensate Tank	-	1%	$0.01	$	$8	$	1.5
Repair Leaks	-	1%	$0.01	$	$6	$	0.9
Lighting							
Upgrade to LED	750	43%	$0.04	$	$42	$$	2.8
Upgrade to Fluorescent	280	20%	$0.27	$$$	$293	$$$	11.7
Other	190	13%	$0.07	$$	$73	$$	4.7
Install OccupancySensors	140	10%	$0.06	$$	$68	$$	5.4
Upgrade Exterior Lighting	60	7%	$0.03	$	$36	$$	3.7
Install Bi-level Lighting	40	3%	$0.08	$$	$76	$$	7.5
Install Photocell Control	-	1%	$0.04	$	$45	$$	3.7
Upgrade Exit Signs to LED	-	2%	$0.01	$	$12	$	2.5
Replace with LED	-	1%	$0.01	$	$12	$	3.1
Upgrade to Flourescent	-	0%	$0.00	$	$1	$	1.6
Delamp	-	0%	$0.01	$	$12	$	1.1
Other							
Motors – Install VFDs	280	20%	$0.14	$$	$174	$$$	2.3
Other – Other	160	12%	$0.18	$$	$193	$$$	8.3
Process and Plug Loads – Other	120	7%	$0.64	$$$	$743	$$$$	8.2
Submetering – Install Submetering	130	5%	$0.73	$$$	$737	$$$$	3.1
Motors – Upgrade Motors	40	33%	$0.05	$$	$54	$$	7.9
Install Solar/Photovoltaic	30	9%	$0.21	$$	$230	$$$	4.3
Replace Washing Machines	10	10%	$0.02	$	$27	$$	7.1
Motors – Remove Motors	-	4%	$0.02	$	$25	$$	1.2

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

	Cost per Square Foot	Cost per Unit	Payback (years)
$	< $0.05	$ < $20.00	0–3
$$	$0.05-$0.25	$$ $20.00-$100.00	3.1–5
$$$	$0.26-$1.00	$$$ $100.01-$500.00	5.1–10
$$$$	> $1.00	$$$$ > $500	10.1–100

Table 14 (continued): ECMs Organized by Greatest Energy Savings by Category: This table compares the cost and payback of the all of the ECMs in each category, organized by greatest potential energy savings.

Energy Conservation Measure	Potential Source Energy Savings (GBTU*)	Frq. of Recs	Cost per SF		Cost per Unit		Payback (years)
Ventilation & Cooling							
Install TRVs	580	6%	$0.29	$$$	$329	$$$	5.6
Install Indoor Sensors	380	4%	$0.21	$$	$238	$$$	2.1
Ventilation – Other	340	34%	$0.15	$$	$159	$$$	6.4
Replace Chiller	210	5%	$3.12	$$$$	$4,257	$$$$	11.9
HVAC Controls and Sensors – Other	110	2%	$0.08	$$	$88	$$	1.4
Upgrade Exhaust Fans	110	17%	$0.29	$$$	$298	$$$	9.6
Install CAR Dampers	80	6%	$0.61	$$$	$611	$$$$	11.9
Install Exhaust Fan Timers	40	15%	$0.01	$	$10	$	1.0
Zone control upgrades	10	0%	$0.14	$$	$140	$$$	10.1
Cooling System – Other	-	8%	$0.16	$$	$221	$$$	6.3
Upgrade packaged units	-	5%	$0.23	$$	$236	$$$	68.8
Replace Packaged Units	-	5%	$0.13	$$	$135	$$$	18.7
Install Demand Control Ventilation	-	7%	$0.06	$$	$56	$$	16.2

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

	Cost per Square Foot	Cost per Unit	Payback (years)
$	< $0.05	< $20.00	0–3
$$	$0.05-$0.25	$20.00-$100.00	3.1–5
$$$	$0.26-$1.00	$100.01-$500.00	5.1–10
$$$$	> $1.00	> $500	10.1–100

Table 15: List of ECMs in Each Category

Domestic Hot Water

- Add Condensing Boiler for DHW Load
- Condensing Domestic Hot Water Heaters
- Decrease DHW Temperature
- DHW System / Water - Low Flow Sink Aerators
- Domestic Water
- Install DHW Controls
- Install Low-Flow Aerators
- Install Low-Flow Showerheads
- Install Solar Thermal DHW
- Insulate DHW Piping
- Insulate DHW Tank
- Insulate Domestic Hot Water Piping
- Insulate Pipes
- Other
- Reduce Setpoint
- Replace Piping
- Replace Tankless COil
- Separate DHW from Heating
- Upgrade DHW Boiler

Envelope

- Add Window Films
- Exterior Door Replacement
- Increase insulation - Floor
- Increase insulation - Roof
- Increase insulation - Wall
- Install Cool or Green Roof
- Other
- Replace Glazing and Frames
- Replace Windows
- Sealing - Door
- Sealing - Room AC
- Sealing - Vertical Shafts
- Sealing - Windows
- Weatherstripping for Exterior Doors

Fuel Switching

- #2 Oil to Natural Gas
- #6 Oil or #4 Oil to #2 Oil
- #6 Oil or #4 Oil to Natural Gas
- #6 to dual fuel
- District Steam to On-site Generation
- Heating
- Other
- Utility steam to on-site generation

Heating & Distribution

- Distribution System - Capture and Return Condensate
- Distribution System - Install or Upgrade Master Venting
- Distribution System - Insulate Ducts
- Distribution System - Insulate Pipes
- Distribution System - Other
- Distribution System - Repair Leaks
- Distribution System - Replace or Repair Main Steam Trap
- Distribution System - Replace or Repair Steam Traps
- Distribution System - Replace or Repair Vacuum Pump
- Distribution System - Replace Piping
- Distribution System - Seal Ducts
- Distribution System - Upgrade PTACs
- Distribution System - Upgrade Pumps
- Distribution Systems - Insulate Pipes
- Heating System - Boiler Stack Damper
- Heating System - Clean & Tune Boiler/Furnace
- Heating System - Electric to Hydronic Conversion
- Heating System - Heat Recovery - Heating Only
- Heating System - Heat Recovery from Utility Steam
- Heating System - Hot Water Temperature Reset Adjustment
- Heating System - Install Barometric Damper
- Heating System - Install or Upgrade EMS/BMS
- Heating System - Install Thermostatic Damper
- Heating System - Insulate Condensate Tank
- Heating System - Other

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

Cost per Square Foot		Cost per Unit		Payback (years)
$	< $0.05	$	< $20.00	0–3
$$	$0.05-$0.25	$$	$20.00-$100.00	3.1–5
$$$	$0.26-$1.00	$$$	$100.01-$500.00	5.1–10
$$$$	> $1.00	$$$$	> $500	10.1–100

Table 15 (continued): Complete List of ECMs Organized Alphabetically: This table breaks down all of the ECMs within each of the five categories.

Heating & Distribution (continued)

Heating System - Re-insulate Heating Hot Water Piping
Heating System - Replace Boiler
Heating System - Replace Boiler Jacket
Heating System - Replace Burner
Heating System - Replace Steam Control Valves
Heating System - Steam to Hydronic Conversion
Heating System - Upgrade Boiler
Heating System - Upgrade Burner
HVAC - Cooling - PTAC Window Unit SEER Upgrade
HVAC - Heating - Heating Boiler Upgrade
HVAC Controls & Sensors - Change Set Points / Setbacks - Heating
HVAC Controls & Sensors - Install Indoor Sensors
HVAC Controls & Sensors - Install or Upgrade EMS/ BMS
HVAC Controls & Sensors - Install Programmable Thermostats
HVAC Controls & Sensors - Install TRVs
HVAC Controls & Sensors - Nighttime and Weekend HVAC Scheduling
HVAC Controls and Sensors - Other
HVAC Controls and Sensors - Reinstall Heating COil Actuators
HVAC Controls and Sensors - Replace Outdoor Reset
HVAC Controls and Sensors - Zone Control Upgrades

Lighting

Electrical - CFL to LED Lighting
Electrical - T12 to T8 Common Areas
Delamp
Elevator Lighting Upgrade
Exterior Lighting
High Efficiency Lighting
Install Bi-level Lighting
Install Dimming Stairwell Fixtures
Install Occupancy Sensors in Low to Medium Traffic Areas
Install Occupancy/Vacancy Sensors
Install Photocell Control
Install Timers
Interior Lighting
Other
Replace with Flourescent
Replace with LED
Upgrade Exit Signs to LED
Upgrade Exterior Lighting
Upgrade to Flourescent
Upgrade to Fluorescent
Upgrade to LED

Ventilation & Cooling

Cooling System - Add or Upgrade Cooling Tower
Cooling System - High Efficiency Split System Air Conditioners
Cooling System - Other
Cooling System - Replace Chiller
Cooling System - Replace packaged units
Cooling System - Upgrade Chiller
Cooling System - Upgrade packaged units
HVAC Controls and Sensors - Change Set Points / Setbacks - Cooling
Ventilation - Building Air Balance
Ventilation - Install CAR Dampers
Ventilation - Install Demand Control Ventilation
Ventilation - Install Exhaust Fan Timers
Ventilation - Other
Ventilation - Upgrade Exhaust Fans
Ventilation - Upgrade Fan/Air Handlers

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

Table 15 (continued): Complete List of ECMs Organized Alphabetically: This table breaks down all of the ECMs within each of the five categories.

Other

Conveying Systems - Add Elevator Regenerative Drives
Conveying Systems - Other
Conveying Systems - Upgrade Controls
Conveying Systems - Upgrade Motors
Motors - Install Timers
Motors - Install VFDs
Motors - Other
Motors - Remove Motors
Motors - Upgrade Motors
On Site Generation - Install Cogeneration Plant
On Site Generation - Install Solar/Photovoltaic
On Site Generation - Other
Other - Install VFDs
Other - Other
Process and Plug Loads - Other
Process and Plug Loads - Replace Washing Machines
Submetering - Install Submetering

Legend

- Domestic Hot Water
- Heating & Distribution
- Ventilation & Cooling
- Envelope
- Lighting
- Fuel Switching
- Other

BEEx: the building energy exchange connects New York City real estate and design communities to energy and lighting efficiency solutions through exhibitions, education, technology demonstrations, and research. We identify opportunities, navigate barriers to adoption, broker relationships, and showcase best practices at our resource center in the Surrogate's Courthouse.

be-exchange.org

report

Extended ECM Tables
July 2015 Draft

Retrofitting Affordability

be ex

building energy exchange

Report Partners:

BRIGHT POWER

sustainable energy partnerships