



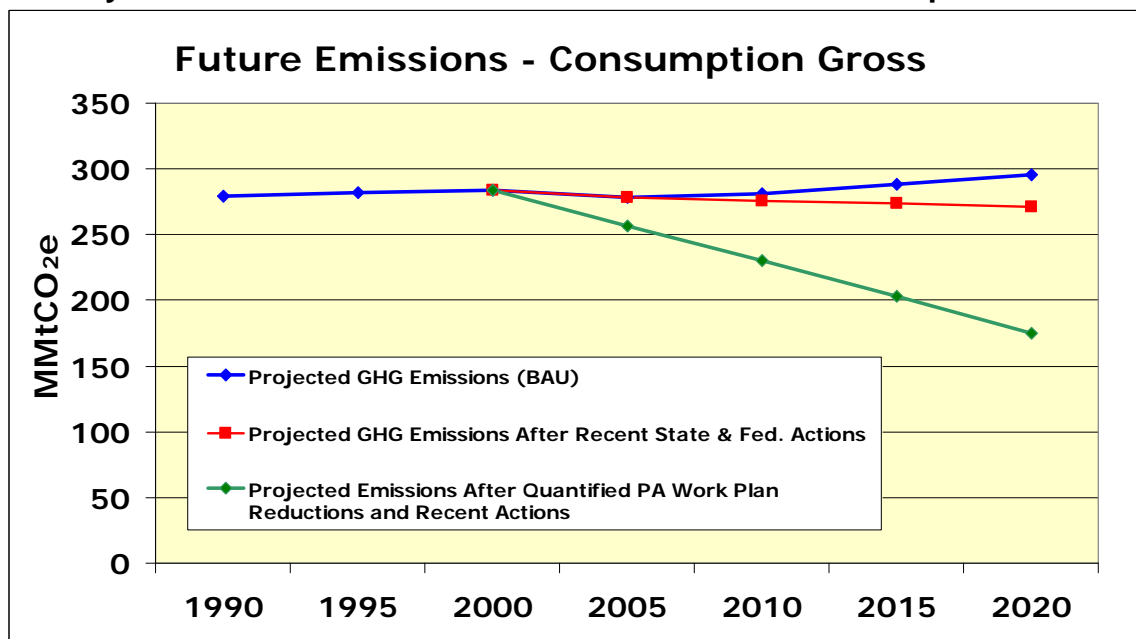
Pennsylvania Climate Work Plan Overview

Pennsylvania's Climate Change Act, Act 70 of 2008, was signed into law by Governor Edward G. Rendell on July 9, 2008. Act 70 required the following actions, among others, of the Department of Environmental Protection (DEP):

- Develop a report on the climate change impacts and opportunities for Pennsylvania
- Develop a greenhouse gas (GHG) inventory and establish a baseline from which future emissions projections can be made
- Create a GHG inventory for emissions and emissions reductions
- Develop a climate change action plan

Act 70 also established a Climate Change Advisory Committee (CCAC) composed of representatives from the scientific, business and industry, transportation, environmental, social, outdoor and sporting, labor and other affected communities. The Governor, the state Senate and House each selected six members, and the Secretaries of Conservation and Natural Resources and Community and Economic Development and the Chair of the Public Utility Commission also served. The PA DEP incorporated the CCAC's recommendations in the state's draft Climate Action Plan released in December 2009. Their potential greenhouse gas (GHG) reductions are shown below (green line).

Pennsylvania GHG Reduction Potential from Recent and Proposed Actions



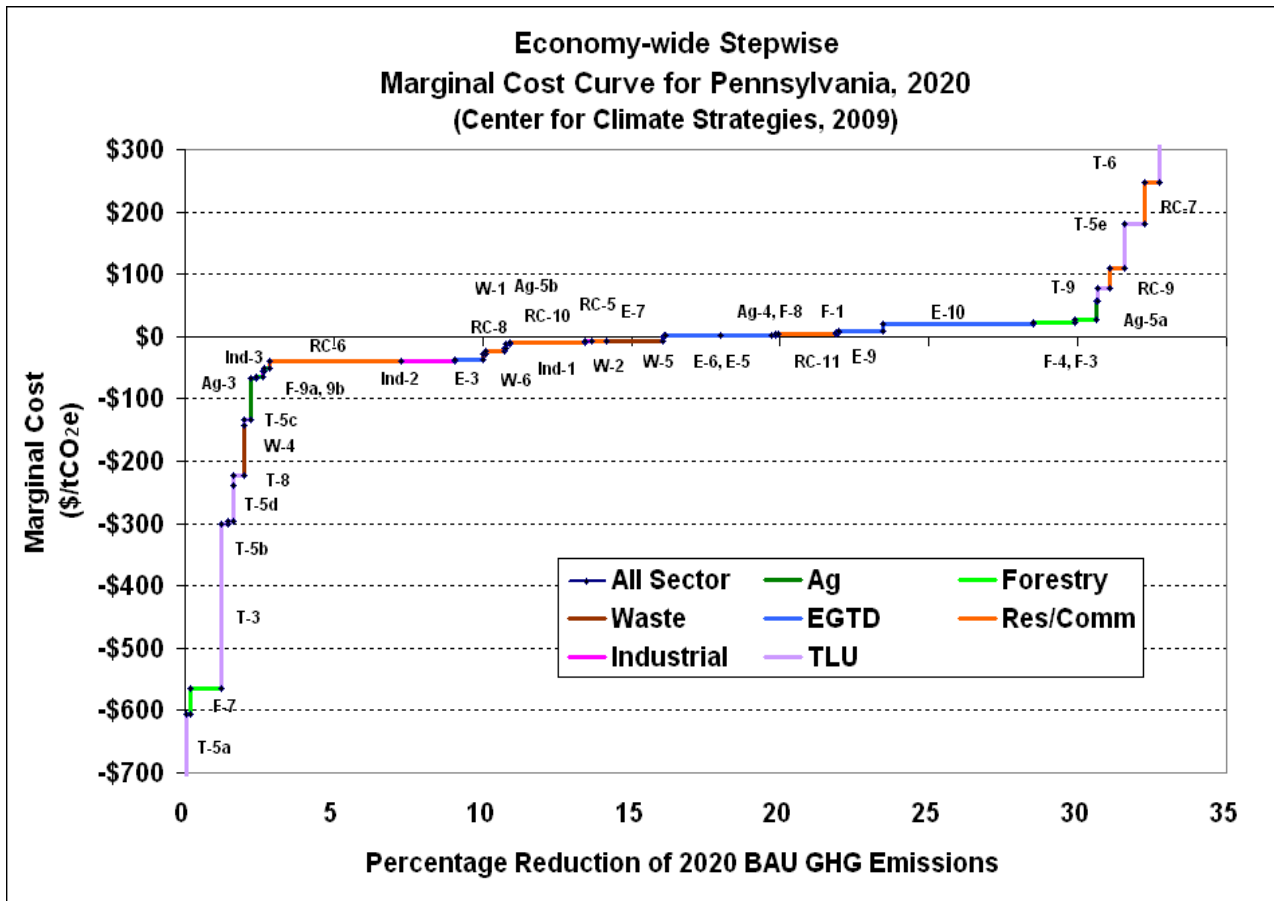
MMtCO₂e = million metric tons of carbon dioxide equivalent; GHG = greenhouse gas; BAU = business-as-usual.

During CCAC’s deliberations federal energy efficiency requirements for new appliances and light-duty vehicles, and federal alignment with the California car standards were enacted. State actions undertaken included the Alternative Energy Portfolio Standard and Act 129’s requirements for electric energy savings and demand reductions, new diesel/truck idling controls, and cleaner fuels from Biofuel Development and In-State Production Incentive Act. All will lower missions forecasts (red line in chart above).

The DEP contracted with the [Center for Climate Strategies \(CCS\)](#) to provide technical and analytical support CCAC in assessing the GHG reduction potentials and cost effectiveness of the measures considered. CCAC’s five sector-based subcommittees are:

- Agriculture and Forestry
- Energy Generation, Transmission and Distribution
- Industry and Waste
- Land Use and Transportation
- Residential and Commercial

The cost curve below shows the cost effectiveness of many of the CCAC’s specific policy recommendations in these sectors (represented by each color coded and labeled line segment) in terms of their savings or costs and their contribution to reducing GHGs. Negative values (below the \$0 midline) represent net cost savings, and positive values (above the midline) represent net costs associated with the policy option.



MMtCO₂e = million metric tons of carbon dioxide equivalent; EGTD = Energy Generation, Transmission and Distribution; TLU = Transportation and Land Use; Res/Comm = Residential and Commercial [building energy use]

The CCAC's recommendations included in the state's Climate Action Plan offer additional GHG reductions beyond state and federal actions from multiple sectors. The following tables summarize CCAC's recommendations in each sector and their impacts.

CCAC Energy Generation, Transmission, and Distribution Recommendations							
Work Plan No.	Recommendation	Annual Results (2020)			Cumulative Results (2009-2020)		
		GHG Reductions (MMtCO ₂ e)	Costs (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$)	Cost-Effectiveness (\$/tCO ₂ e)
2	Reduced Load Growth	7	-\$432	-\$64	23	-\$849	-\$36
3	Stabilized Load Growth	9	-\$593	-\$64	27	-\$990	-\$36
5	Carbon Capture and Sequestration in 2014	5	\$291	\$58	13	\$391	\$31
6	Improve Coal-Fired Power Plant Efficiency by 5%	5	\$82	\$1	55	\$903	\$1
7	Sulfur Hexafluoride (SF ₆) Emission Reductions from the Electric Power Industry	0.1	\$0.1	\$0.6	0.7	\$0.3	\$0.4
8	Analysis to Evaluate Potential Impacts Associated with Joining RGGI	See Appendix D					
9	Promote Combined Heat and Power (CHP)	4	\$53	\$12	23	\$209	\$9
10	Nuclear Capacity	154	\$83274	\$5720	3420	\$655233	\$2412
11	Greenhouse Gas Performance Standard for New Power Plants	Qualitative Work Plan--Not Quantified					
12	Transmission and Distribution Losses	Qualitative Work Plan--Not Quantified					
Sector Total After Adjusting for Overlaps		3221	\$1,006248	\$3412	434120	\$4,060638	\$85
Recent State Actions²		15	-\$1,001 to \$285	-\$91 to 26	116	-\$2,790 to \$1,560	-\$37 to \$21
1	Act 129 of 2008 (HB 2200) (Already in Electricity Baseline Forecast)	4	-\$258	-\$65	40	-\$1,409	-\$35
4a	Alternative Energy Portfolio (Act 213 of 2004) Tier I Standard (No Price Suppression)	11	\$285	\$26	76	\$1,560	\$21
4b	Alternative Energy Portfolio (Act 213 of 2004) Tier I Standard (Moderate Price Suppression)	11	-\$358	-\$33	76	-\$615	-\$8
4c	Alternative Energy Portfolio (Act 213 of 2004) Tier I Standard (Full Price Suppression)	11	-\$1,001	-\$91	76	-\$2,790	-\$37
Sector Total Plus Recent Actions		47	See Ranges above	See Ranges above	247	See Ranges above	See Ranges above

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; NPV = net present value; RGGI = Regional Greenhouse Gas Initiative.

¹ Electricity 1 and 4 are recent Commonwealth of Pennsylvania actions.

² Totals are shown as a range reflecting the estimated GHG emission reductions and cost savings associated with Act 129 and the GHG emission reductions and range of costs / savings associated with the three Alternative Energy Portfolio Standard scenarios (i.e., without price suppression effects and with a moderate and high price suppression effects scenario).

CCAC Residential and Commercial Building Sector Recommendations							
Work Plan No.	Policy Recommendation	Annual Results (2020)			Cumulative Results (2009-2020)		
		GHG Reductions (MMtCO ₂ e)	Costs (Million \$)	Cost Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$)	Cost Effectiveness (\$/tCO ₂ e)
1-4	High-Performance Buildings (Total for RC-1 Through RC-4)	31.9	-\$256.3	-\$8.0	139.7	-\$1,653	-\$11.8
1	High-Performance State and Local Government Buildings	2.7			11.3		
2	High-Performance School Buildings	1.9			7.8		
3	High-Performance Commercial (Private) Buildings	9.0			37.4		
4	High-Performance Homes (Residential)	18.3			83.1		
5	Commissioning and Retro-commissioning PA Buildings	1.5	-\$17	-\$11.2	9.6	-\$71	-\$7.4
6	Re-Light Pennsylvania	12.9	-\$823	-\$64	103.2	-\$4,020	-\$39
	Residential	3.5	-\$328	-\$95	30.0	-\$1,887	-\$63
	Commercial—lighting power density	5.3	-\$367	-\$69	30.7	-\$806	-\$26
	Commercial—fixture performance	4.0	-\$136	-\$34	33.9	-\$1,039	-\$31
	Commercial—daylighting	0.8	-\$64	-\$82	5.0	-\$204	-\$41
	Commercial—controls	2.1	\$108	\$52	14.3	\$511	\$36
	Commercial—parking lot lighting	1.1	-\$117	-\$103	10.5	-\$613	-\$58
	Commercial—exit signs	0.0	-\$1	-\$64	0.1	-\$6	-\$44
7	Re-Roof Pennsylvania	1.4	\$472	\$327	4.3	\$1,064	\$247
	Light-colored, insulated roofs	0.2	-\$4	-\$18	0.8	\$13	\$17
	Green roofs	0.1	\$77	\$614	0.3	\$147	\$462
	PV roof	1.1	\$399	\$359	3.2	\$903	\$282
8	PA buys EE appliances	1.9	-\$68	-\$36	12.4	-\$291	-\$24
9	Geothermal Heating and Cooling	1.4	\$224	\$158	8.0	\$879	\$109
10	DSM - Natural Gas	7.3	-\$51	-\$7	40.5	-\$357	-\$9
11	Conservation and Fuel switching for Heating Oil	5.7	-\$21	-\$4	35.8	\$140	\$4
13	DSM - Water	0.1	-\$255	-\$1,944	0.8	-\$1,011	-\$1,285
14	Renew PA buildings PA Values Embodied Energy in Building Materials, Including Historic Structures	Not quantified					
15	Sustainability Education Programs	Not quantified					
16	Adaptive Building Reuse	Not quantified					
Sector Total After Adjusting for Overlaps		32.25	-\$538	-\$17	214.5	-\$3,668	-\$17
Reductions From Recent Federal		5.07	-\$145	-\$28	29.9	-\$567	-\$19.0
Federal Appliance Standards - Electricity		4.77			28.7		
Federal Appliance Standards - Natural Gas		0.3			1.2		
Sector Total Plus Recent Actions		37.4	-\$683	-\$18	244.4	-\$4,235	-\$17

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; NPV = net present value; EE = energy efficiency;

Note: Negative numbers indicate costs savings.

CCAC Land Use and Transportation Sector Recommendations								
Work Plan No.	Recommendation	Annual Results (2020)			Cumulative Results (2009-2020)			
		GHG Reductions (MMtCO ₂ e)	Costs (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	
3	Low-Rolling-Resistance Tires	0.68	-\$212	-\$310	4.1	-\$1,244	-\$300	
5	Eco-Driving	PAYD	0.43	-\$277	-\$651	1.76	-\$1,065	-\$605
		Feebates	0.41	-\$133	-\$320	2.74	-\$810	-\$296
		Driver Training	0.62	-\$129	-\$206	4.53	-\$605	-\$134
		Tire Inflation	0.09	-\$27	-\$282	0.58	-\$137	-\$238
		Speed Reduction	1.96	\$185	\$94	23.0	\$4,153	\$181
6	Utilizing Existing Public Transportation Systems	0.05	\$300	\$6,000	0.55	\$3,000	\$5,454	
7	Increasing Participation in Efficient Passenger Transit	0.12	<\$0	<\$0	2.02	<\$0	<\$0	
8	Cutting Emissions From Freight Transportation	0.99	-\$293	-\$295	6.67	-\$1,495	-\$224	
9	Increasing Federal Support for Efficient Transit and Freight Transport in PA	1.17	\$92	\$78	12.87	\$1,008 ¹	\$78	
10	Enhanced Support for Existing Smart Growth/Transportation and Land-Use Policies	0.76-1.84	<\$0	<\$0	3.79-9.18	<\$0	<\$0	
11	Transit-Oriented Design, Smart Growth Communities, & Land-Use Solutions	Included in T-10	<\$0	<\$0	Included in T-10	<\$0	<\$0	
Sector Total After Adjusting for Overlaps		6.6	-\$494	-\$75	60.1	\$2,805	\$47	
Reductions From Recent State and Federal Actions		15.7	-\$109 ³	-\$31 ³	72.0	-\$380 ²	-\$25 ³	
1	Pennsylvania Clean Vehicles (PCV) Program	0.095	0.0	0.0	1.27	0.0	0.0	
	Federal Vehicle GHG Emissions and CAFE Standards	12.2	NQ	NQ	57.3	NQ	NQ	
2	Biofuel Development and In-State Production Incentive Act	3.47	-\$89	-\$26	14.8	-\$203	-\$14	
4	Diesel Anti-Idling Program	0.07	-\$20	-\$273	0.7	-\$177	-\$238	
Sector Total Plus Recent Actions		22.3	-\$603	-\$27	132	\$2,425	\$18	

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; NPV = net present value; NQ = not quantified; PA = Pennsylvania; PAYD = Pay-As-You-Drive; CAFE = Corporate Average Fuel Economy.

Items 1, 2, and 4 are recent state actions that are being implemented by the state; and the federal government will be implementing national vehicle GHG emissions and corporate average fuel economy (CAFE) standards starting in 2012.

¹ T-9 uses federal dollars exclusively, cost figures for T-9 are calculations of how many federal dollars—not state dollars—would be required to implement the work plan.

² This cost per ton value excludes the emission reductions associated with the “Federal Vehicle GHG Emissions and CAFE Standards” since costs (savings) were not quantified for this recent federal action.

CCAC Industry Sector Recommendations							
Work Plan No.	Recommendation	Annual Results (2020)			Cumulative Results (2009-2020)		
		GHG Reductions (MMtCO ₂ e)	Costs (Million \$)	Cost Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$)	Cost Effectiveness (\$/tCO ₂ e)
1	Coal Mine Methane (CMM) Recovery	0.57	-\$5.9	-\$10.3	6.38	-\$51.8	-\$8.03
2	Industrial Natural Gas and Electricity Best Management Practices	5	-\$348	-\$68	25	-\$972	-\$38
3	Reduce Lost and Unaccounted for Natural Gas	0	-\$11	-\$84	1	-\$48	-\$55
Sector Total After Adjusting for Overlaps		6	-\$365	-\$62	33	-\$1,072	-\$33
Reductions From Recent State and Federal Actions		0.0	\$0.0	\$0.0	0.0	\$0.0	\$0.0
Sector Total Plus Recent Actions		6	-\$365	-\$62	33	-\$1,072	-\$33

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; NPV = net present value.

CCAC Waste Sector Recommendations							
Work Plan No.	Recommendation	Annual Results (2020)			Cumulative Results (2009-2020)		
		GHG Reductions (MMtCO ₂ e)	Costs (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$)	Cost-Effectiveness (\$/tCO ₂ e)
1	Landfill Methane Displacement of Fossil Fuels	0.1	-\$0.1	-\$0.8	0.56	-\$11	-\$19
2	Statewide Recycling Initiative	5.44	-\$41	-\$8	34.4	-\$246	-\$7
4	Improved Efficiency at Wastewater Treatment Facilities	3.8 x 10 ⁻³	-\$0.5	-\$126	0.023	-\$3.2	-\$143
5	Waste-to-Energy Digesters	0.1	\$0.1	\$1.0	0.60	\$0.7	\$1.2
6	Waste-to-Energy MSW	0.24	-\$8.1	-\$34	1.42	-\$40	-\$28
Sector Total After Adjusting for Overlaps		5.9	-\$50	-\$8	37	-\$299	-\$8
Reductions From Recent State and Federal Actions		0.0	\$0.0	\$0.0	0.0	\$0.0	\$0.0
Reductions From Recent State and Federal Actions		5.9	-\$50	-\$8	37	-\$299	-\$8

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; NPV = net present value; NQ = not quantified; MSW = municipal solid waste.

CCAC Agriculture Sector Recommendations								
Work Plan No.	Recommendation		Annual Results (2020)			Cumulative Results (2009-2020)		
			GHG Reductions (MMtCO ₂ e)	Costs (Million \$)	Cost-Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$)	Cost-Effectiveness (\$/tCO ₂ e)
1	Foodshed Development Strategy		Not Quantified ¹					
2	Next-Generation Biofuels		Costs and GHG savings from biofuels are considered in Transportation-2 and Residential-11 Work Plans					
3	Management-Intensive Grazing		0.62	-\$59	-\$95	5.50	-\$369	-\$67
4	Manure Digester Implementation Support	Dairy	0.26	-\$0.3	-\$1	1.46	\$2	\$2
		Swine	0.04	\$0.1	\$4	0.23	\$1	\$5
5	Regenerative Farming Practices		0.059	\$2.1	\$36	0.30	\$17	\$56
	Soil Sequestration from Continuous No-Till Agronomic Systems		0.44	-\$5	-\$11	2.7	-\$31	-\$12
Sector Total After Adjusting for Overlaps			1.42	-\$62	-\$44	10.2	-\$380	-\$37
Reductions From Recent State and Federal Actions			0.0	\$0.0	\$0.0	0.0	\$0.0	\$0.0
Sector Total Plus Recent Actions			1.42	-\$62	-\$44	10.2	-\$380	-\$37

¹ The CCAC recommends this for topic for research and analysis .
GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; NPV = net present value.

Agriculture sector recommendations, next page

CCAC [Forestry Work Plan Recommendations](#)

Work Plan No.	Work Plan Name	Annual Results (2020)			Cumulative Results (2009-2020)			
		GHG Reductions (MMtCO ₂ e)	Costs (Million \$2007)	Cost-Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$2007)	Cost-Effectiveness (\$/tCO ₂ e)	
Forest Growth and Protection/Avoided Conversion								
1*	Forest Protection Initiative -- Easement	0.178	\$0	\$0	12.22	\$67.5	\$5.53	
3*	Forestland Protection and Avoided Conversion -- Acquisition							
Option	Total acreage protected	Development threat						
A	80,000	100%	0.178	\$0	\$0	14.60	\$236.4	\$16.19
A	80,000	50%	0.178	\$0	\$0	8.23	\$236.4	\$28.71
A	80,000	20%	0.178	\$0	\$0	4.41	\$236.4	\$53.58
A	80,000	10%	0.178	\$0	\$0	3.14	\$236.4	\$75.33
A	240,000	100%	3.72	\$37.1	\$9.99	41.68	\$590.9	\$14.18
A*	240,000	50%	2.13	\$37.1	\$17.47	22.57	\$590.9	\$26.18
A	240,000	20%	1.17	\$37.1	\$31.74	11.11	\$590.9	\$53.20
A	240,000	10%	0.85	\$37.1	\$43.62	7.28	\$590.9	\$81.12
A	400,000	100%	7.26	\$72.2	\$10.23	68.76	\$945.3	\$13.75
A	400,000	50%	4.07	\$72.2	\$18.23	36.91	\$945.3	\$25.61
A	400,000	20%	2.16	\$72.2	\$34.35	17.80	\$945.3	\$53.11
A	400,000	10%	1.52	\$72.2	\$48.70	11.43	\$945.3	\$82.71
B	64,745	100%	1.7	\$18.50	\$10.69	10.98	\$226.6	\$13.22
B	129,556	100%	3.5	\$36.99	\$10.69	21.97	\$453.4	\$13.22
B	259,046	100%	6.9	\$73.99	\$10.69	43.94	\$906.7	\$13.22
B	129,556	20%	0.9	\$36.99	\$40.11	5.47	\$453.4	\$53.14
B	129,556	10%	0.6	\$36.99	\$61.16	3.40	\$453.4	\$85.35
Increased Utilization of Durable Wood Products								
2	Woodnet				<i>Qualitative work plan</i>			
6*	Durable Wood Products							
	1.12 Bbf/year (2006 PA harvest)*		0.73	NQ	NQ	8.77	NQ	NQ
	1.5 Bbf/year		0.98	NQ	NQ	11.74	NQ	NQ
	80 Mbf/year (2006 State Forest harvest)		0.04	NQ	NQ	0.46	NQ	NQ
Reforestation, Afforestation, Regeneration								
4	Reforestation, Afforestation, Regeneration		3.98	\$41.9	\$10.52	25.89	\$568.7	\$21.97
5	Improved Forest Management							
Scenario	Shift to uneven-aged management							
1	Shift 20% of even-aged management to uneven-aged		0.26	NQ	NQ	0.82	NQ	NQ

Work Plan No.	Work Plan Name	Annual Results (2020)			Cumulative Results (2009-2020)		
		GHG Reductions (MMtCO ₂ e)	Costs (Million \$2007)	Cost-Effectiveness (\$/tCO ₂ e)	GHG Reductions (MMtCO ₂ e)	Costs (NPV, Million \$2007)	Cost-Effectiveness (\$/tCO ₂ e)
2	Shift 50% of even-aged management to uneven-aged	0.65	NQ	NQ	2.04	NQ	NQ
3	Shift 75% of even-aged management to uneven-aged	0.97	NQ	NQ	3.07	NQ	NQ
Scenario	Restock understocked forestland**						
1	Restock 100% of poorly stocked forest	(5.1)	\$66.8	\$13.08	(75.1)	\$1,063	\$14.15
2	Restock 100% of poorly stocked forest and 50% of moderately stocked forest	(26.3)	\$264.4	\$10.04	359.1)	\$4,209	\$11.72
3	Restock 100% of poorly stocked forest and 100% of moderately stocked forest	(47.6)	\$462.1	\$9.71	(643.1)	\$7,355	\$11.44
Urban Forestry							
7*	Urban Forestry						
	Increment existing urban forest by 10%	1.20	-\$560	-\$468.15	7.78	-\$4,399	-\$565.74
	Increment existing urban forest by 25%*	2.99	-\$1,400	-\$468.15	19.44	-\$10,997	-\$565.74
	Increment existing urban forest by 50%	5.98	-\$2,800	-\$468.15	38.88	-\$21,994	-\$565.74
Wood-based Energy							
8*	Wood to Electricity	0.26	\$0.18	\$0.67	1.71	\$2.8	\$3.14
9*	Biomass Thermal Energy Initiatives						
	Combined heat and power*	0.47	-\$21.1	-\$45.30	3.03	-\$151.5	-\$50.03
	Fuels for Schools*	0.61	-\$33.9	-\$55.23	3.99	-\$258.8	-\$64.78
Sector Total After Adjusting for Overlaps*		11.3	-\$1,376	-\$121	98	-\$10,177	-\$104
Reductions From Recent State and Federal Actions		0.0	\$0.0	\$0.0	0.0	\$0.0	\$0.0
Sector Total Plus Recent Actions		11.3	-\$1,376	-\$121	98	-\$10,177	-\$104

GHG = greenhouse gas; MMtCO₂e = million metric tons of carbon dioxide equivalent; \$/tCO₂e = dollars per metric ton of carbon dioxide equivalent; NPV = net present value; Mbf = thousand board feet; Bbf = billion board feet; NQ = Not Quantified.

* An asterisk identifies the work plan number and name included in the "Sector Total after Adjusting for Overlaps."

** For the F-5 scenario (i.e., restocking of undestocked forestlands), the analysis estimates an emissions increase relative to baseline conditions associated with site preparation and planting, and these increases are recorded in parenthesis.