Appendix E
Methods for Quantification

This appendix describes in brief the methods used in quantifying the greenhouse gas (GHG) emission reductions and costs / cost savings associated with the policy recommendations, and provides examples of the distinction between "direct" and "indirect" costs. In addition, the combined impacts of all of the policy recommendations within and between each sector were estimated as if all of the recommendations were implemented together. This involved eliminating any overlaps in coverage of affected entities that would occur to avoid double-counting of impacts. These methods are based on those widely accepted among climate change mitigation policy analysts.

Methods for Quantifying Impacts of Policy Recommendations

- **Focus of Analysis:** Net GHG reduction potential in physical units of million metric tons of carbon dioxide equivalent ($MMtCO_2e$) and net cost per metric ton reduced in units of dollars/tCO_2e.
- **Geographic Inclusion:** Measure GHG impacts of activities that occur within the state, regardless of the actual location of emissions reductions.
- **Direct vs. Indirect Effects:** Define "direct effects" as those borne by the entities implementing the policy recommendation. For example, direct costs are net of any benefits or savings to the entity. Define "indirect effects" as those borne by the entities other than those implementing the policy recommendation. Quantify these indirect effects on a case-by-case basis depending on magnitude, importance, need and availability of data. (See additional discussion and list of examples below.)
- **Non-GHG (Ancillary) Impacts and Costs:** Include in qualitative terms where deemed important. Quantify on a case-by-case basis as needed depending on need and where data are readily available.
- **Discounted and "Levelized" Costs:** Discount a multi-year stream of net costs (total costs net of any savings) to arrive at the "net present value cost" of an policy. Discount costs in constant 2005 dollars using a 5% annual real discount rate for the period 2008 through 2025. Capital investments are represented in terms of levelized or amortized costs through 2025. Create a "levelized" cost per ton by dividing the "present value cost" by the cumulative reduction in tons of GHG emissions. This is a widely used method to estimate the "dollars per ton" cost of reducing GHG emission (all in CO_2 equivalence). A "levelized" cost is a "present value average" used in a variety of financial cost applications.
- **Time Period of Analysis:** Count the impacts of actions that occur during the project time period and, using levelized emissions reduction and cost analysis, report emissions reductions and costs for specific target years such as 2015 and 2025. Where additional GHG reductions or costs occur beyond the project period as a direct result of actions taken during the project period, show these for comparison and potential inclusion.

- **Aggregation of Impacts:** Avoid simple double counting of GHG reduction potential and cost when adding emission reductions and costs associated with all of the policy recommendations. Note and or estimate interactive effects between policy recommendations using analytical methods where overlap is likely.
- **Policy Design Specifications:** Include timing, goal levels, implementing parties, and the type of implementation mechanism.
- **Transparency:** Include data sources, methods, key assumptions, and key uncertainties. Use data and comments provided by the Minnesota Climate Change Advisory Group (MCCAG) and Technical Work Groups (TWGs) to improve data sources, methods, and key assumptions using their expertise and knowledge to address specific issues in Minnesota.

The approaches here do not necessarily take a “standard” benefit-cost perspective as used in regulatory policy impact analysis. For instance, there is no direct/indirect distinction under standard procedures; one takes the “societal perspective” and tallies everything, and quantifies where possible. Regarding GHG mitigation costs, often the best available data are focused at the level of implementation as opposed to the societal level. Regarding GHG benefits, market prices (monetized benefits) are normally taken as good proxies of societal costs and benefits in standard analysis unless there are market imperfections or subsidies that create distortionary effects. Because accurate information on the dollar value of GHG reduction benefits is typically not available, physical benefits are used instead, measured as $MMtCO_2e$.

The “direct cost” approach described here is useful in estimating the costs (and benefits) to the implementing entity (e.g., person, company, governmental body, etc.) “Indirect costs” (and benefits) are those experienced by other entities in society. In examining utility demand-side management (DSM) programs for gas and electric utilities, analysts sometimes look at three perspectives: “participant,” “non-participant,” and “societal” (the latter being equivalent to “standard” benefit-cost perspective). Depending on program design, “direct cost” to a DSM participant can be high or low (if the latter, it may be attributable to a shifting of some costs to non-participants).

Note also that the “direct cost” approach does not necessarily account for market imperfections or subsidies. Typically, a state perspective on “direct costs” takes any federal government subsidies as a given. For example, substantial federal government subsidies exist for some alternative fuels. If the existing market price (with subsidy) of the alternative fuel is used in cost analysis, the option appears as relatively low cost. If the subsidy was included in the cost analysis (i.e., looking at societal costs in the standard benefit-cost perspective), then the alternative fuel would appear more costly.

For additional reference see the economic analysis guidelines developed by the Science Advisory Board of the US EPA available at: http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html.

Examples of Direct/Indirect Net Costs and Benefits

Note: These examples are meant to be illustrative. They are not necessarily included in the specific policy recommendations in this report.

Residential, Commercial, and Industrial (RCI) Sectors

Direct Costs and/or Benefits

- Net capital costs (or incremental costs relative to standard practice) of improved buildings, appliances, equipment (cost of higher-efficiency refrigerator versus refrigerator of similar features that meets standards)
- Net operation and maintenance (O&M) costs (relative to standard practice) of improved buildings, appliances, equipment, including avoided/extra labor costs for maintenance (less changing of compact fluorescent light (CFL) or light-emitting diode (LED) bulbs in lamps relative to incandescent)
- Net fuel (gas, electricity, biomass, etc.) costs (typically as avoided costs from a societal perspective)
- Cost/value of net materials use/savings (for example, raw materials savings via recycling, or lower/higher cost of low-global-warming-potential [GWP] refrigerants)

Indirect Costs and/or Benefits

- Re-spending effect on economy
- Net value of employment impacts
- Net value of health benefits/impacts
- Value of net environmental benefits/impacts (e.g., value of damage by air pollutants on structures, crops)
- Net embodied energy of materials used in buildings, appliances, equipment, relative to standard practice
- Improved productivity as a result of an improved working environment, such as improved office productivity through improved lighting (though the inclusion of this as indirect might be argued in some cases)

Energy Supply (ES) Sector

Direct Costs and/or Benefits

- Net capital and transmission costs (or incremental costs relative to reference case technologies) of renewables or other advanced technologies resulting from policies
- Net O&M costs (relative to reference case technologies) renewables or other advanced technologies resulting from policies
- Avoided or net fuel savings (e.g., gas, coal, biomass) of renewables or other advanced technologies relative to reference case technologies resulting from policies
- Total system costs (net capital + net O&M + avoided/net fuel savings + net imports/exports + net transmission and distribution [T&D] costs) relative to reference case total system costs

Indirect Costs and/or Benefits

- Re-spending effect on economy
- Higher cost of electricity reverberating through economy

- Energy security
- Net value of employment impacts
- Net value of health benefits/impacts
- Value of net environmental benefits/impacts (e.g., value of damage by air pollutants on structures, crops)

Agriculture, Forestry, and Waste Management (AFW) Sectors

Direct Costs and/or Benefits

- Net capital costs (or incremental costs relative to standard practice) of facilities or equipment (e.g., manure digesters and associated infrastructure, generator; ethanol production facility; composting facility; land acquisition or easement purchases; reforestation projects; urban tree planting programs)
- Net O&M costs (relative to standard practice) of equipment or facilities
- Net fuel (e.g., gas, electricity, biomass) costs or avoided costs
- Cost/value of net water use/savings or other avoided costs (e.g., avoided landfilling costs)

Indirect Costs and/or Benefits

- Net value of employment impacts
- Net value of human health benefits/impacts
- Net value of ecosystem health benefits/impacts (e.g., wildlife habitat; reduction in wildfire potential)
- Value of net environmental benefits/impacts (e.g., value of damage by air or water pollutants on structures, crops)
- Net value of fuel consumption derived from in-state production sources relative to standard sources
- Reduced VMT and fuel consumption associated with land use conversions (e.g., as a result of forest/rangeland/cropland protection policies)

Transportation and Land Use (TLU) Sectors

Direct Costs and/or Benefits

- Incremental cost of more efficient vehicles net of fuel savings.
- Incremental cost of implementing Smart Growth programs, net of saved infrastructure costs.
- Incremental cost of mass transit investment and operating expenses, net of any saved infrastructure costs or savings (e.g., roads)
- Incremental cost of alternative fuel, net of any change in maintenance costs

Indirect Costs and/or Benefits

- Health benefits of reduced air and water pollution.
- Ecosystem benefits of reduced air and water pollution.

- Value of quality-of-life improvements.
- Value of improved road safety.
- Energy security
- Net value of employment impacts

Methods for Quantifying Cumulative Impacts of Overlapping Policy Recommendations

In addition to estimating the impacts of each individual policy recommendations, *combined* impacts of the policy recommendations in each sector were estimated assuming that all were implemented together. This involved eliminating any overlaps in coverage that would occur to avoid double-counting of impacts. Also, some of the policy recommendations in one sector overlapped with policy recommendations in another sector; therefore, these overlaps were identified and the impact analysis was adjusted to eliminate double counting of impacts associated with these inter-sector overlaps. The following identifies where these overlaps occurred and explains the methods used to adjust the impacts analysis to avoid double counting of impacts.

RCI Cumulative Impacts Analysis Methodology

In order to assess the cumulative emissions reductions for the policies in the RCI sectors, it is necessary to consider any overlaps among the policies that affect similar types of energy use. Specifically, some policies (such as RCI-1) are defined by their usage reduction goals, while others are defined by addressing a specific type of energy use. In these cases it is important to consider whether addressing the specific energy use would add to the overall reductions, or just be subsumed into the more general reduction goal.

In order to address this issue, two approaches were used to determining whether a policy recommendation would have an incremental impact over and above the more general DSM goals. First, it was asked whether the policy had a specific funding mechanism that would set it apart from other measures to reduce energy use. Then, it was asked whether the sector addressed by the measure was covered under a more general goal. To address the issues of potential overlap, each option was examined relative to the option coverage by fuel, as summarized in the chart below. Then, each fuel type was addressed individually to assess potential overlap.

Table E-1. Impact of RCI-5

Option No.	Option Name	Electricity	Natural Gas	Fuel Oil	Propane	Biomass	Other Fuels
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)	X					
RCI-2	Improved Uniform Statewide Building Codes	X	X				
RCI-3	Green Building Guidelines and Standards Based on the *Architecture 2030 Challenge*	X	X	X	X		X
RCI-4	Incentives and Resources To Promote CHP	X	X	X		X	X
RCI-5	Reduction of High GWP Emissions						
RCI-6	Non-Utility Strategies and Incentives	X	X	X		X	X
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency			X	X		
RCI-8	Energy Performance Disclosure	*Not quantified*					
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*					
RCI-10	Appliance Standards	X	X				
	Coverage by Number of Options	6	5	4	2	2	3

Table E-2. Electricity

Option No.	Option Name	Electricity	Potential overlap with RCI-1?	Justification	Proposal for GHG reduction credit in integrated analysis
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)	X	N/A	N/A	100%
RCI-2	Improved Uniform Statewide Building Codes	X	No	Savings would be incremental to the CIP	100%
RCI-3	Green Building Guidelines and Standards Based on the *Architecture 2030 Challenge*				
RCI-4	Incentives and Resources To Promote CHP	X	No	Savings would be incremental to the CIP	100%
RCI-5	Reduction of High GWP Emissions				
RCI-6	Non-Utility Strategies and Incentives	X	No	Savings would be incremental to the CIP	100%
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency				
RCI-8	Energy Performance Disclosure	*Not quantified*			

Option No.	Option Name	Electricity	Potential overlap with RCI-1?	Justification	Proposal for GHG reduction credit in integrated analysis
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*			
RCI-10	Appliance Standards	X	Yes	High efficiency appliances a likely utility strategy to achieve CIP targets	50%

N/A = either not applicable or not analyzed.

Table E-3. Natural Gas

Option No.	Option Name	Natural gas	Potential overlap with RCI-3?	Justification	Proposal for GHG reduction credit in integrated analysis
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)				
RCI-2	Improved Uniform Statewide Building Codes	X	N/A	Savings would be incremental to the "*Architecture 2030 Challenge*"	100%
RCI-3	Green Building Guidelines and Standards Based on the *Architecture 2030 Challenge*	X	N/A	N/A	100%
RCI-4	Incentives and Resources To Promote CHP	X	No	Savings would be incremental to the *Architecture 2030 Challenge*	100%
RCI-5	Reduction of High GWP Emissions				
RCI-6	Non-Utility Strategies and Incentives	X	No	Savings would be incremental to the *Architecture 2030 Challenge*	100%
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency				
RCI-8	Energy Performance Disclosure	*Not quantified*			
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*			
RCI-10	Appliance Standards	X	Yes	Savings would be incremental to the *Architecture 2030 Challenge*	50%

N/A = either not applicable or not analyzed.

Table E-4. Fuel Oil

Option No.	Option Name	Fuel oil	Potential overlap with RCI-7?	Justification	Proposal for GHG reduction credit in integrated analysis
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)				
RCI-2	Improved Uniform Statewide Building Codes				
RCI-3	Green Building Guidelines and Standards Based on the *Architecture 2030 Challenge*	X	No	Savings would be incremental to fuel oil/propane conservation	100%
RCI-4	Incentives and Resources To Promote CHP	X	No	Savings would be incremental to fuel oil/propane conservation	100%
RCI-5	Reduction of High GWP Emissions				
RCI-6	Non-Utility Strategies and Incentives	X	No	Savings would be incremental to fuel oil/propane conservation	100%
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency	X	N/A	N/A	100%
RCI-8	Energy Performance Disclosure	*Not quantified*			
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*			
RCI-10	Appliance Standards				

N/A = either not applicable or not analyzed.

Table E-5. Propane

Option No.	Option Name	Propane	Potential overlap with RCI-7?	Justification	Proposal for GHG reduction credit in integrated analysis
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)				
RCI-2	Improved Uniform Statewide Building Codes				
RCI-3	Green Building Guidelines and Standards Based on the *Architecture 2030 Challenge*	X	No	Savings would be incremental to fuel oil/propane conservation	100%
RCI-4	Incentives and Resources To Promote CHP				
RCI-5	Reduction of High GWP Emissions				
RCI-6	Non-Utility Strategies and Incentives				
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency	X	N/A	N/A	100%
RCI-8	Energy Performance Disclosure	*Not quantified*			
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*			
RCI-10	Appliance Standards				

N/A = either not applicable or not analyzed.

Table E-6. Biomass

Option No.	Option Name	Biomass	Potential overlap with RCI-4?	Justification	Proposal for GHG reduction credit in integrated analysis
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)				
RCI-2	Improved Uniform Statewide Building Codes				
RCI-3	Green Building Guidelines and Standards Based on the *Architecture 2030 Challenge*				
RCI-4	Incentives and Resources To Promote CHP	X	N/A	N/A	100%
RCI-5	Reduction of High GWP Emissions				
RCI-6	Non-Utility Strategies and Incentives	X	No	Savings would be incremental to CHP	100%
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency				
RCI-8	Energy Performance Disclosure	*Not quantified*			
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*			
RCI-10	Appliance Standards				

N/A = either not applicable or not analyzed.

Table E-7. Other fuels

Option No.	Option Name	Other fuels	Potential overlap with RCI-3?	Justification	Proposal for GHG reduction credit in integrated analysis
RCI-1	Maximize Savings From the Utility Conservation Improvement Program (CIP)				
RCI-2	Improved Uniform Statewide Building Codes				
RCI-3	Green Building Guidelines and Standards Based on the *Architecture 2030 Challenge*	X	N/A	N/A	100%
RCI-4	Incentives and Resources To Promote CHP	X	No	Savings would be incremental to the *Architecture 2030 Challenge*	100%
RCI-5	Reduction of High GWP Emissions				
RCI-6	Non-Utility Strategies and Incentives	X	No	Savings would be incremental to the *Architecture 2030 Challenge*	100%
RCI-7	Conservation Improvement-Type Program for Propane and Fuel Oil Efficiency				
RCI-8	Energy Performance Disclosure	*Not quantified*			
RCI-9	Promote Technology-Specific Applications To Reduce GHG Emissions	*Not quantified*			
RCI-10	Appliance Standards				

N/A = either not applicable or not analyzed.

Interaction of RCI Policy Recommendations with Other Sectors

RCI and Energy Supply:

- The primary interaction between RCI and Energy Supply policies is that the RCI policies decrease overall electricity demand, thereby reducing the impact of RPS programs (ES-2), which are designed to serve a certain percentage of electricity sales from renewable sources. This reduction is accounted for in the ES sector adjustments
- The CHP option (RCI-4) was modeled in the energy supply analysis.

There are no significant overlaps between RCI and any of the other sectors.

ES Cumulative Impacts Analysis Methodology

The dominant policy recommendation for promoting renewable energy resource development is ES-5, mandated renewable energy standard (RES). There are two other renewable options, ES-3 (biomass co-firing at coal power stations) and ES-12 (distributed renewables). These were modeled as incremental to the RES. The remaining quantified option, ES-4 (transmission system upgrading) modeled the natural gas system, and was modeled as incremental to all ES options.

Interaction of Energy Supply Policy Recommendations with Other Sectors

ES and RCI:

- As indicated in the RCI sector cumulative impact analysis, the primary interaction between ES and RCI policies is that the RCI policies decrease overall electricity demand, thereby reducing the impact of the RES programs (ES-5) which are designed to serve a certain percentage of electricity sales from renewable sources. The GHG reductions and cost-effectiveness calculations are therefore included in the ES sector.

ES and AFW:

There are no overlaps between ES and the AFW sectors. All biomass used in co-firing is incremental to that used in the AFW sectors.

ES and TLU:

There are no overlaps between ES and the TLU sectors.

TLU Cumulative Impacts Analysis Methodology

CCS calculated the net cumulative impact of the TLU policy recommendations in order to account for overlap and interaction among policies. The GHG reductions resulting from individual stand-alone policies are not necessarily additive. For example, a policy that reduces VMT will reduce the GHG benefits of a policy that improves vehicle fuel economy or reduces fuel carbon intensity; a mile not driven removes the opportunity to reduce the carbon content of the fuel that would otherwise have been used to drive that mile.

A spreadsheet analysis was used to calculate net cumulative impacts. The first step in this analysis was to identify all the policies that affect VMT and determine the net VMT impact of this subset. The next step is to correct for overlaps between the policies. Table E-8 summarizes which recommended policies were analyzed as overlapping, and thus corrected, and which would be essentially additive, and therefore not corrected.

Table E-8. TLU Sector Overlaps

Policy No.	Policy Recommendation	Overlapping/ corrected	Stand-alone/ not corrected
TLU-1	Improved Land-Use Planning and Development Strategies	X	
TLU-2	Expand Transit, Bicycle, and Pedestrian Infrastructure	X	
TLU-5	Climate-Friendly Transportation Pricing/Pay-as-You- Drive	X	
TLU-7	"Fix-it-First" Transportation Investment Policy and Practice	X	
TLU-9	Workplace Tools To Encourage Carpooling, Bicycling, and Transit Ridership	X	
TLU-14	Freight Mode Shifts: Intermodal and Rail		X
TLU-3	Low-GHG Fuel Standard	X	
TLU-4	Infrastructure Management	X	
TLU-6	Adopt California Clean Car Standards	X	
TLU-12	Voluntary Fleet Emission Reductions		X
TLU-13	Reduce Maximum Speed Limits	X	

TLU-12 and -14 affect only heavy-duty vehicles and therefore have no overlap with other policies.

The net cumulative GHG reduction from the TLU policy recommendations (9.3 $MMtCO_2e$ in 2025) is 12.2% lower than the sum of the individual policy impacts.

Interaction of TLU Policy Recommendations with Other Sectors

TLU-3, the Low-GHG Fuel Standard, would likely overlap with AFW-3: In-State Liquid Biofuels Production: elements B (fossil diesel displacement) and C (gasoline displacement) have a direct overlap with the TLU low carbon fuels standard. The AFW recommendation focuses on in-state production, while the TLU policy focuses on biofuels consumption. CCS assumed 100% overlap in the benefits. So these were removed from the AFW sector level totals (after overlap adjustments) in the summary table of the Appendix.

Overlap Adjustments to TLU Sector:

Based on the assumptions above, the cumulative TLU total, adjusted for overlaps, would be as shown in Table E-9.

Table E-9. Overlap Adjustments to TLU Sector

TLU SECTOR	2015 GHG Reductions ($MMtCO_2e$)	2025 GHG Reductions ($MMtCO_2e$)	2008–2025 GHG Reductions ($MMtCO_2e$)	2008–2025 Costs (Savings) (Net Present Value Million $)	2008-2025 Cost-Effectiveness ($/t$CO_2$e)
Totals of Individual Policies without Adjustments for Overlaps	5.1	10.6	103.1	*Not Calculated*	
Totals Adjusted for Overlaps Among Policies	4.7	9.3	91.2	*Not Calculated*	

$MMtCO_2e$ = million metric tons of carbon dioxide equivalent

* Totals from all 8 TLU recommendations with estimated GHG reductions.

† Totals from only those 4 TLU recommendations with estimated costs/cost savings.

AFW Cumulative Impacts Analysis Methodology

AFW-7&8

These waste management policy recommendations have a significant interaction with one another, such that they could be considered a single broad municipal solid waste management policy recommendation. AFW-7 is focused on reducing waste generation and managing waste using the most GHG-beneficial practices (enhanced recycling and composting). To the extent that AFW-7 is successfully implemented, it will reduced the amount of waste left over for management using the “end of life” waste management practices under AFW-8. GHG reductions and costs have been estimated for each of these policies assuming that the other would not have been adopted, and these are shown in the summary table of the AFW appendix. An additional “incremental analysis” was conducted and documented in the appendix under AFW-8 to address the overlap between these recommendations. For example, if AFW-7 is fully-implemented, there is no waste available for the organics and waste-to-energy element (WTE) of AFW-8. The stand-alone and overlap-adjusted results are shown in Table E-10.

Table E-10. Stand-Alone and Overlap Adjustments for AFW-7&8

AFW SECTOR Recommendation	2015 GHG Reductions ($MMtCO_2e$)	2025 GHG Reductions ($MMtCO_2e$)	2008-2025 GHG Reductions ($MMtCO_2e$)	2008–2025 Costs (Savings) (Net Present Value Million $)	2008-2025 Cost-Effectiveness ($/t$CO_2e$)
Stand-Alone Estimates					
AFW-7. Front-End Waste Management	**3.39**	**7.40**	**70**	**–$438**	**–$6**
A. Source Reduction	0.00	3.6	20	$59	$3
B. Recycling	3.10	3.4	45	–$512	–$11
C. Composting	0.29	0.41	4.9	$15	$3
AFW-8 End of Use Waste Management Practices	**0.96**	**2.19**	**20**	**$913**	**$46**
A. Landfilled Waste Methane	0.066	0.73	4.4	$5.7	$1
B. Organics & WTE	0.52	0.63	8.1	$650	$80
C. WTE Preprocessing	0.37	0.84	7.9	$257	$32
Overlap-Adjusted Estimates					
AFW-7. Front-End Waste Management	**3.39**	**7.40**	**70**	**–$438**	**–$6**
AFW-8 End of Use Waste Management Practices	**0.19**	**0.42**	**5.1**	**$120**	**$24**
A. Landfilled Waste Methane	0.023	0.25	1.5	$3.8	$3
B. Organics & WTE	0.00	0.00	0.00	Not applicable	Not applicable
C. WTE Preprocessing	0.17	0.17	3.6	$116	$32
Total AFW 7&8 Overlap-Adjusted Estimates					
AFW-7&8	**3.58**	**7.82**	**75**	**–$318**	**–$4**

$MMtCO_2e$ = million metric tons carbon dioxide equivalent; WTE = waste to energy; negative numbers represent cost savings

Interaction of AFW Policy Recommendations with Other Sectors

AFW-3: In-State Liquid Biofuels Production: elements B (fossil diesel displacement) and C (gasoline displacement) have a direct overlap with the TLU low carbon fuels standard. The AFW recommendation focuses on in-state production, while the TLU policy focuses on biofuels consumption. CCS assumed 100% overlap in the benefits. So these were removed from the AFW sector level totals (after overlap adjustments) in the summary table of the Appendix. However, it should be recognized that there could be additional GHG benefits (and economic benefits) for producing these fuels in-state rather than from out of state sources (due to lower transportation-related emissions).

AFW-4: Expanded Use of Biomass Feedstocks for Electricity, Heat or Steam Production: This option overlaps with ES-5 (Renewable and/or Environmental Portfolio Standard). In consultation with the ES TWG, CCS determined that the amount of biomass required for the ES option would exceed that envisioned to be produced under AFW-4. Also, the cost analysis for ES-5 provides an assumed cost for biomass which would offset the biomass production costs under AFW-4.

Therefore, CCS assumed a 100% overlap in both the benefits and costs for this option with ES-5. This is reflected in the appendix summary table totals (after adjusting for overlaps).

Overlap Adjustments to AFW Sector

Based on the assumptions above, the cumulative AFW totals, adjusted for overlaps, are as shown in Table E-11.

Table E-11. Overlap Adjustments to AFW Sector

AFW SECTOR	2015 GHG Reductions ($MMtCO_2e$)	2025 GHG Reductions ($MMtCO_2e$)	2008-2025 GHG Reductions ($MMtCO_2e$)	2008–2025 Costs (Savings) (Net Present Value Million $)	2008-2025 Cost-Effectiveness ($\$/tCO_2e$)
Totals of Individual Policies without Adjustments for Overlaps	19.9	48.7	440	$2,785	$6
Totals Adjusted for Overlaps Among Policies	13.2	29.5	279	$1,890	$7

$MMtCO_2e$ = million metric tons carbon dioxide equivalent.