Agriculture Technical Work Group
Summary List of High Priority Mitigation Options

DRAFT

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2007–2020 (Million $)	Cost-Effective-ness ($/tCO_2e$)	Status of Option
		2012	2020	Total 2007 2020			
AW-1	Manure Digesters/Other Waste Energy Utilization	0.15	0.79	4.23	94	22.38	Ready for TWG review
AW-2	In-State Production of Biofuels and Biofuels feedstocks						In progress
AW-3	Significantly Expand Source Reduction, Reuse, Recycling and Composting	1.30	4.76	29.21	-353	-12.10	Ready for full CAT review
AW-4	Agricultural Carbon Management						In progress
AW-5	Agricultural Nutrient Management						In progress
AW-6	Reductions In On-Farm Energy Use and Improvements in Energy Efficiency						In progress
AW-7	Preserve Open Space/Agricultural Land	0.75	1.11	10.42	167	16.05	Ready for TWG review
AW-8	Support for an Integrated Regional Food System	Not Quantified					In progress
	Sector Total After Adjusting for Overlaps						
	Reductions From Recent Actions (table to be added below)						
	Sector Total Plus Recent Actions						

AW-1. Manure Digesters/Other Waste Energy Utilization

Mitigation Option Description

Anaerobic digestion of manure from concentrated animal feeding operations (specifically dairy feedlots) is a critical and commercially available technology for reduction of direct methane emissions and the indirect offset of fossil fuel related energy production. Co-digestion of manure with high solids municipal wastes generates technical and economic benefits for both waste-streams.

Capture and recovery of "biogas" from stored animal manure and municipal wastes directly reduces emissions of methane to the atmosphere. Biogas is a low-BTU form of biologically produced natural gas, and therefore can be used to produce thermal and electrical energy as well as liquid fuel and alternative products.

Mitigation Option Design

- **Goals:**
  - Reduce methane emissions by diversion of open stored animal waste to anaerobic digestion – using waste from approximately 150,000 cows.
  - Reduce methane emissions through co-digestion of high solids municipal wastes with animal manures – using approximately 207,000 tons of high solids municipal wastes (50% of food waste, 20% of yard waste) annually.
  - Substitute bio-gas for non-renewable sources for the production of electricity – from methane from an equivalency of 100,000 cows + equivalent amount of MSW from goal #2.
  - Substitute bio-methane for non-renewable petroleum based vehicle fuels – using methane from an equivalency of 50,000 cows + equivalent amount of MSW from goal #2.
  - Substitute carbon and nutrient based co-products from anaerobic digestion for materials and nutrients derived through fossil fuel combustion and/ or mining and various other products.
- **Timing:**
  - Construction of farm-based digesters for an average of 15,000 cows / year between 2010 and 2020.
  - Production of electricity as primary energy utilization technology through ~2015, with production of compressed / liquefied biomethane taking over as primary energy utilization technology after 2015.
  - Rerouting of high solid municipal wastes to farm-based digesters at an increasing rate of 20,700 tons per year until a total of 207,000 tons per year in 2020 (50% of food waste and 20% of yard waste).

- **Coverage of parties:** Washington State University, Western Washington University, Washington State Department of Agriculture, Washington State Department of Ecology, Washington State Department of Transportation, public and private utilities, Conservation Districts, Municipal Government / Transit Fleets, private sector
- **Other:** Additional co-products generated in the anaerobic digestion process also have the potential to replace other CO_2 emission intense products such as materials and nutrients derived through fossil fuel combustion and/ or mining and various other products. Many of these products remain in the research and development pipeline, but will be commercially viable well before 2020. The potential for crediting reductions in CO_2 intensity is anticipated as significant.

Implementation Mechanisms

All municipals need to have solid waste plans and waste audits (not done very often). We need to update our county-by-county waste characterization audits for Municipals.

Question about paper wastes – non-recyclables like pizza boxes.

Need different collection systems for different types of waste streams on the municipal side. It's a lot different to divert these wastes than it is to divert recyclables.

Incentives for diversion of existing waste streams.

Related Policies/Programs in Place

1. **Washington Department of Ecology Beyond Waste Plan**: Recommendation ORG 6, http://www.ecy.wa.gov/beyondwaste/p_org06.html.
2. **Energy Freedom Loan:**
   - **South Yakima Conservation District** – $2 million.
   - **Port of Sunnyside,** Dairy Anaerobic Digester -- $1,972,715
   - **Tulalip Tribes**, Qualco Dairy Digester -- $1,500,266
3. **Ecology / WSU partnership**: Supplemental funding continues research on high solids anaerobic digester, and biomass inventory.
   - **Producing Energy and Fertilizer** (high solids anaerobic digester). http://www.ecy.wa.gov/biblio/0707024.html
   - **Biomass Inventory Technology and Economics Assessment** http://www.ecy.wa.gov/biblio/0707025.html
4. WSU Climate Friendly Farming Project / related WSU activities
   - Monitoring of commercial anaerobic digestion facilities for GHG mitigation, technical, and economic performance
   - Development and evaluation of AD co-products for improved economic performance: horticultural planting media; ammonia recovery, phosphorous recover
   - Development of novel anaerobic digestion technology
   - Evaluation of pathogen control by anaerobic digesters
   - Evaluation of co-digestion of municipal solid waste with animal manures
   - Evaluation of land application of digested substrates for efficacy as commercial fertilizers
   - Incubation of residual dairy solids after AD for stable carbon
   - Research and development of biogas scrubbing and compression technology for use as a liquid fuel – in partnership with Western Washington University's Vehicle Research Institute

– Industry-oriented educational program, including workshops, field days, extension bulletins / publications, website.

Types(s) of GHG Reductions

- Direct Reductions of Methane
- Offsets of fossil fuel derived electricity and liquid fuel

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

- **Data Sources:**

The study by Turnbull *et al*. provided average emissions per dairy, both with and without anaerobic digestion.[1] Sources that were consulted in the development of GHG reduction estimates resulting from the anaerobic digestion (and corresponding energy utilization) of high-solids municipal solid waste (MSW) included Mohareb *et al.*[2] and Frear *et al.*[3] ***to be completed by CCS***

- **Quantification Methods:**

Greenhouse Gas Reductions

The previously cited study by Turnbull *et al.* is a case study that provides life-cycle emissions of two 400-head dairy operations: one with anaerobic digestion (AD) and one without. The AD scenario is found to produce 13,892,103 kg CO_2e over its 50 year life, while the reference dairy produced 67,672,196 kg CO_2e over the same 50 years. Converting these numbers to metric tons and dividing by the lifecycle of the farms and the number of cows on each farm, the emissions per head were derived. The reference scenario produced 3.38 $MtCO_2$e per head per year, while the AD scenario produced 0.69 $MtCO_2$e per head per year. The incremental GHG reduction that is achieved through utilization of AD technology and energy capture on dairy operations is 2.69 $MtCO_2$e per head per year. This value is used as the per-head emission reduction factor for each head where the end product is biogas used for electricity consumption.

Bio-methane emissions reduction methodology (dairy)

Biogas emissions reduction methodology (MSW)

Process	Food (tonnes CO_{2e}/tonne waste)	Yard (tonnes CO_{2e}/tonne waste)
Net AD emissions	-0.27	-1.12
Net Landfill emissions	1.14	-0.16
Net Compost	-0.11	-0.88

[1] Turnbull, J.H., et.al. 2005. Greenhouse Gas Benefits of an Anaerobic Digester in the USA IEA Bioenergy: T38: 2005: 03. www.joanneum.at/iea-bioenergy-task38

[2] Mohareb, A.K., M. Warith, and R.M. Narbaitz. 2004. Strategies for the municipal solid waste sector to assist Canada in meeting its Kyoto Protocol commitments. Environ. Rev. 12: 71–95

[3] Frear C., M. Fuchs, B. Zhao, G. Fu, M. Richardson and S. Chen. 2005.Biomass Inventory and Bioenergy Assessment: An Evaluation of Organic Material Resources for Bioenergy Production in Washington State. A Collaborative Project between the Washington Department of Ecology and Washington State University's Department of Biological Systems Engineering.

Bio-methane emissions reduction methodology (MSW)

Biogas electricity emissions reduction methodology (dairy & MSW)

Bio-methane vehicle fuel emissions reduction methodology (dairy & MSW)

The targets set forth in the "Timing" section above state that this policy is to achieve 10% of the goals in the first policy year, increasing linearly from that point, until the end of the policy period – 2020. The dairy portion of this option sets a target of 150,000 total cattle controlled, and the waste portion of this option sets a target of 207,000 tons per year diverted to AD facilities by 2020. Additionally, the option design calls for the conversion of a portion of the biogas generated each year after 2015 into bio-methane, which can be used as a substitute for compressed natural gas (CNG), a potential alternative transportation fuel. The target for 2020 is to convert one third of biogas from each source into bio-methane usable for vehicle fuel. The table below describes the annual schedule of policy application to dairy cows and food and yard waste:

Table X:

Year	Dairy Population Controlled (head)	Dry Food Waste Controlled (tons)	Dry Yard Waste Controlled (tons)	No. of Cows earmarked for biogas	No. of Cows earmarked for bio-methane	Tons of Waste earmarked for biogas	Tons of Waste earmarked for bio-methane
2010	-	-	-	-	-	-	-
2011	15,000	12,301	8,430	15,000	-	20,730	-
2012	30,000	24,601	16,860	30,000	-	41,461	-
2013	45,000	36,902	25,289	45,000	-	62,191	-
2014	60,000	49,202	33,719	60,000	-	82,921	-
2015	75,000	61,503	42,149	75,000	-	103,652	-
2016	90,000	73,803	50,579	80,000	10,000	110,562	13,820
2017	105,000	86,104	59,008	85,000	20,000	117,472	27,640
2018	120,000	98,404	67,438	90,000	30,000	124,382	41,460
2019	135,000	110,705	75,868	95,000	40,000	131,292	55,280
2020	150,000	123,006	84,298	100,000	50,000	138,202	69,101

For each year, the emission factors described above were applied to the dairy cows and tons of waste displayed in Table X. The result is a GHG reduction of 0.15 $MMtCO_2e$ in 2012 and a reduction of 0.79 $MMtCO_2e$ in 2020. The estimated cumulative GHG reduction throughout the policy period is 4.23 $MMtCO_2e$.

Table X: GHG Emissions Reductions

Year	Net Emissions Reductions (Dairy, MMtCO2e)	Net Emissions Reductions (MSW, MMtCO2e)	Bio-gas Electricity Emission Reduction (MMtCO2e)	Bio-methane vehicle fuel reduction (MMtCO2e)	Avoided Emissions
2010	-	-	-	-	-
2011	0.04	0.01	0.02	-	0.07
2012	0.08	0.02	0.05	-	0.15

2013	0.12	0.03	0.07	-	0.22
2014	0.16	0.04	0.10	-	0.30
2015	0.20	0.05	0.12	-	0.37
2016	0.24	0.06	0.13	0.02	0.46
2017	0.28	0.07	0.14	0.05	0.54
2018	0.32	0.08	0.14	0.07	0.62
2019	0.36	0.09	0.15	0.10	0.71
2020	0.40	0.10	0.16	0.12	0.79
Totals:	2.22	0.56	1.08	0.37	4.23

Cost Effectiveness

- **Key Assumptions:**

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation:**
- **Reduced Fuel Import Expenditures:**

Key Uncertainties

[Insert text here]

Additional Benefits and Costs

Enhancement and stabilization of dairy industry and the concomitant agricultural working land, with the addition of new revenue sources for energy production, MSW tipping fees, and AD byproducts.

Question on whether tipping fees could upset MSW system? We need to be careful with how state policy is crafted around tipping fees.

The shift from traditional manure storage and utilization to AD has the potential for a number of ancillary environmental benefits including improved water quality, air quality,

Using bio-methane to substitute for petroleum vehicle fuels reduces air emissions of other air pollutants such as hydrocarbons, nitrogen oxides, and particulates

Anaerobic digestion transforms feedstocks into digestate that can be used as a plant available fertilizer, displacing petroleum-sourced fertilizers.

Feasibility Issues

Expansion of state support for alternative vehicle fuels research, development, production, distribution, and consumption beyond bio-diesel and ethanol to include bio-methane required

Department of Health involvement necessary to significantly add high solid MSW to on farm digesters

Capital costs for AD technology

Scale issues of the application of technology to smaller producers

Farm nutrient plan issues with imported co-feedstocks digestion, exasperating on farm nutrient balance

Bio-security issues for community digesters (used to reduce capital costs) serving multiple animal producers

UTC and similar regulatory impediments limiting sale and export of energy to intermediary parties (electric, gas pipeline utilities)

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

Appendix: References

Baldasano, J.M. and C. Soriano. 2000. Emission of greenhouse gases from anaerobic digestion processes: comparison with other municipal solid waste treatments. Water Science and Technology Vol 41 No 3 pp 275–282

Bishop, C.P., C.R. Shumway, and P.R. Wandschneider. "Adoption of Anaerobic Digestion Technology." Submitted to *Land Economics*.

Bishop, C.P. and C.R. Shumway. "The Economics of Dairy Anaerobic Digestion with Co-Product Marketing." Submitted to *Review of Agricultural Economics*.

Frear C., M. Fuchs, B. Zhao, G. Fu, M. Richardson and S. Chen. 2005.Biomass Inventory and Bioenergy Assessment: An Evaluation of Organic Material Resources for Bioenergy Production in Washington State. A Collaborative Project between the Washington Department of Ecology and Washington State University's Department of Biological Systems Engineering.

Martin, J.H. 2005. An Evaluation of a mesophilic, modified plug flow anaerobic digester for dairy cattle manure. Report submitted to US EPA Ag STAR Program.

Mohareb, A.K., M. Warith, and R.M. Narbaitz. 2004. Strategies for the municipal solid waste sector to assist Canada in meeting its Kyoto Protocol commitments. Environ. Rev. 12: 71–95

NASS. 2002. Census of Agriculture. http://www.nass.usda.gov/Statistics_by_State/Washington/index.asp

Turnbull, J.H., et.al. 2005. Greenhouse Gas Benefits of an Anaerobic Digester in the USA IEA Bioenergy: T38: 2005: 03. www.joanneum.at/iea-bioenergy-task38

AW-2. In-State Production of Biofuels and Biofuels feedstocks

Mitigation Option Description

Washington state is distinctly different as an agricultural production region than the US Midwest – where corn and soybean-based biofuel production has dominated the landscape. Corn production in Washington is biophysically and economically limited to irrigated production as a rotational crop. Biophysical and economic limitations are even more constraining on current oilseed production in the state. Efforts are underway in both the public and private sector to increase the opportunity for Washington farmers to participate in the "traditional" biofuel markets of ethanol and biodiesel. Due to different potential feedstock crop choices and production practices for these fuels, it is likely that the GHG mitigation benefit of Washington ethanol, biodiesel, or other liquid biofuel feedstocks and production methods will be different than those based on Midwest production.

While Washington may not yet be competitive in traditional biofuel crops, we have a significant competitive advantage over other regions with non-traditional biofuel feedstocks and new crops – which ultimately will likely have more significant GHG mitigation benefit. Current research has identified the largest potential for current in-state biofuel feedstocks from: underutilized forest biomass; carbon-based municipal waste; and agricultural processing, field, and animal wastes. Furthermore, research has demonstrated that potential perennial biofuel crops, such as switchgrass, hybrid poplars, and other crops may be far more productive in our region than in other areas of the country.

Finally, any biofuels consideration should consider potential implementation trade-offs. For instance, removal of crop residues for biofuel generation will negatively affect soil carbon sequestration efforts. Biofuel promotion policies need to give consideration to environmental and economic trade-offs. Priority should be given to biofuels and feedstocks that maximize GHG mitigation benefits and minimize impacts on natural ecosystems. In particular, a Low Carbon Fuel Standard (LCFS) sets goals for reducing the carbon intensity of transportation fuels and creates a framework for promoting better performing liquid fuels. A Low Carbon Fuel Standard takes into account full lifecycle emissions and therefore provides new incentives and market value for feedstocks produced with lower emissions and better overall sustainability. We recognize that the CAT is considering a LCFS through Option T-11 in the Transportation TWG. The recommendations included in this Low-Carbon Biofuels option (AW-2) are integrally linked to implementation of the LCFS option (T–11). A LCFS would establish a demand for lower carbon fuels. This option addresses potential in-state feedstock supplies and research & development that are needed to meet the LCFS goal.

Mitigation Option Design

- **Goals:**

*The TWG decided to divide the goals for this proposal between quantifiable GHG reductions and other non-quantifiable goals for the development of a sustainable biofuel industry in the state. The intention of these goals is to push the state's biofuel industry beyond the existing biofuel / crop feedstock options and to give priority consideration to liquid fuels and feedstock crops that have greater relative GHG emission mitigation potential.

Quantifiable GHG mitigation goals:

- Increase utilization of waste biomass for biofuels by 3 million dry tons per year by 2020.
- Increase use of high biomass producing perennial bioenergy-feedstock crops to 80,000 acres by 2020.
- Promote *sustainable* production practices for the estimated 200,000 acres of likely feedstock production for ethanol and biodiesel feedstock crops.

Other Biofuel feedstock crop development goals:

- Give priority consideration for "low-carbon" liquid fuel feedstocks adapted to Washington's unique biophysical and economic conditions.
- Evaluate the opportunity "next generation" biofuels such as compressed biomethane and biobutanol present for Washington-based feedstocks. Invest in research, development and commercialization of next generation biofuel conversion technologies suited to Washington's unique feedstocks.
- Using a lifecycle analysis, assess the energy balance and GHG mitigation benefits of Washington-based biofuels.

- **Timing**
  - Increase utilization of waste biomass for biofuels by 3 million dry tons per year by 2020. Initiation of this practice depends on further development of technologically viable biomass energy conversion technologies (anaerobic digestion of "wet" biomass is ready and improving, thermochemical cellulosic technologies are ready, "biological" cellulosic technologies are estimated to be ready by 2015).
  - Increase use of high-biomass perennial crops (hybrid poplar, switchgrass, etc.) to a total of 80,000 acres by 2020. Initiation of this practice depends on further development of technologically viable biomass energy conversion technologies (thermochemical cellulosic technologies are ready but economically marginal, "biological" cellulosic technologies are estimated to be ready by 2015).
  - Promote *sustainable* production practices on the approximately 200,000 acres in the state now in annual rotation, which are likely to produce corn or oilseeds for the existing commercial biofuels: starch-based ethanol and biodiesel.
- **Coverage of parties:** WSDA, WSU, UW, CTED, Ecology, Conservation Districts, Private Sector
- **Other:** Washington State realizes that we cannot displace all petroleum based fuels with biofuels. We also realize that we have a solid opportunity to reduce a percentage of fuel imports with a regional biofuels production strategy by working with the Western States Climate Action Initiative states/provinces to develop integrated solutions.

Implementation Mechanisms

- Determine the realistic potential for in-state biofuel production from in-state feedstocks by estimating the production of existing crops, existing biomass and new crops for: biodiesel feedstocks, such as oilseed crops, animal fats, algae and waste oil; ethanol feedstocks, such as corn and sugarbeets; and cellulosic feedstocks, including hybrid poplars, perennial grasses, and waste biomass.
- Evaluate the economic and environmental impacts and trade-offs of employing these materials for in-state biofuels production.
- Complete the evaluation of potential biofuel feedstock production and develop a strategy by 2009.
- Evaluate roles for next generation biofuels in the state's consumption matrix of liquid fuels by 2011.
- Develop an R&D investment fund for next generation biofuel conversion technologies suited to Washington's unique feedstocks by 2010.

Related Policies/Programs in Place

Types(s) of GHG Reductions

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

- **Data Sources:**
- **Quantification Methods:**
- **Key Assumptions:**

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation:**
- **Reduced Fuel Import Expenditures:**

Key Uncertainties

[Insert text here]

Additional Benefits and Costs

TBD

Feasibility Issues

WA State welcomes any and all out-of-state interests that are considering locating biofuel facilities here. WA State investments should be made with considerations of community impacts and economic development, and support projects of any scale that utilize low-carbon feedstocks optimized for our growing regions, and production methods measured by a state low-carbon fuel standard.

One method to consider involves considering risk management of regional or community fuel potential over the creation of large scale facilities that require shipment of out of state feedstocks to in-state processing facilities. This decentralized approach would consider regional crop diversities in the right-sizing of processing facilities that support Washington-grown, Washington-owned biofuels.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

AW-3. Significantly Expand Source Reduction, Reuse, Recycling and Composting

Mitigation Option Description

Expand source reduction, reuse, recycling and composting of household, business, industrial, agricultural, and construction-related waste streams to reduce greenhouse gas emissions. Based on data collected for calendar year 2005, existing recycling efforts reduced greenhouse gas emissions in Washington by almost 3.2 million metric ton CO_2 equivalents. This mitigation option, therefore, builds on existing programs and approaches and proposes to take advantage of newer market and business-based activities.

In addition to traditional recycling programs, a partial list of these approaches includes: source reduction (waste prevention) initiatives; expanding existing and encouraging more reuse, recycling, composting and processing businesses; establishing product stewardship programs; using environmentally preferable procurement practices; encouraging cradle-to-cradle design and manufacturing; facilitating safe byproduct "synergy" strategies; achieving a reduction of toxics in packaging and products to make them safer to manufacture, use and recycle while increasing their value and use in the market place; increasing closed-loop recycling and the percentage of recycled-content in products, and expansion of disposal bans.

Mitigation Option Design

- **Goals:**
  - Reduce the total amount of household and business waste by 15% and recycle at least 50% of the waste remaining (see Table 1 for details);
  - Capture for composting[4] over 90 percent of compostable organics (see Table 1 for details).

Table 1. Goals by Household and Business Waste Sources

	Current Recycling Rate	Source Reduction Goal	Recycling Goal	Composting Goal
Aluminum Cans	33%	15%	60%	
Steel Cans	14%	15%	50%	
Glass	26%	15%	50%	
HDPE	20%	15%	50%	
LDPE	91%	15%	91%	
PET	32%	15%	50%	
Corrugated Cardboard	61%	15%	80%	
Newspaper	56%	15%	80%	
Office Paper	44%	15%	60%	

[4] An alternative to composting are anaerobic digestion processes.

Food Scraps	17%	15%		80%
Yard Trimmings	56%	15%		100%
Mixed Waste Paper (general)	28%	15%	60%	
Mixed Metals	83%	15%	90%	
Mixed Plastics	2%	15%	25%	
Mixed Organics	50%	15%		90%

- **Timing:** Achieve 30% of the incremental increase in diversion by 2012. Achieve full goal implementation by 2020.
- **Coverage of parties:** All sectors of society in Washington State will be engaged in attaining this mitigation action, as will many levels of state and local government. The private sector will play a critical role by facilitating the transportation of recyclable materials to processors and composters, by providing processing and composting capacity, and through product stewardship actions. The private sector will likely be invited to take the lead in creating new markets for materials, through expanding existing businesses and services, and establishing new enterprises.
- **Other:** The most important of these goals is to significantly "source reduce" to reduce the generation of discarded material. Currently, while recycling rates are increasing, the overall generation of material discarded has increased dramatically as well. The average amount of garbage (including recyclables) produced by each person in the state increased by 5.3 percent from 2004 to 2005 (from an average of 7.5 pounds of waste per person each day in 2004, to an average of 7.9 pounds a day in 2005). In 2005, residents and businesses in Washington generated almost 18 million tons of solid waste.

  The overarching goal is to have continual improvement and progress toward an eventual "no waste" society, thereby dramatically reducing greenhouse gas emissions and attaining one of the cornerstone principles of sustainability. This can be enabled by taking steps toward product stewardship[5] and the design of products with greenhouse gas emissions, waste prevention, reuse and recycling in mind. This encourages manufacturers to design and manufacture, and for consumers to purchase, products geared towards end-of-life handling methods that conserve, capture, or "recirculate" resources in the most effective and efficient way possible.

  The current situation of increasing waste generation implies increasing consumption and production of goods. The greenhouse gas impacts of production are much larger than emissions from disposal facilities. Washington's greenhouse gas inventory does not fully assign to Washington State the greenhouse gas impacts associated with producing goods that Washington residents and businesses consume. It is in changing the impacts

[5] **Product stewardship** is a product-centered approach to environmental protection. It calls on those in the product lifecycle—manufacturers, retailers, users, and disposers—to share responsibility for reducing the environmental impacts of products. The greatest responsibility lies with whoever has the most ability to affect the lifecycle environmental impacts of the product. Please see the US EPA's Product Stewardship site at http://www.epa.gov/epr/ and the Northwest Product Stewardship Council site at http://www.productstewardship.net

associated with the manufacturing of these products that the greatest greenhouse gas reduction potentials are likely to be found.

Implementation Mechanisms

The effectiveness of a reduction/recycling/composting strategy is dependent on giving programs local flavor using local data. The first step in implementing this strategy should be a local waste disposal and recycling characterization audit in each of the state's 39 counties. The baseline data used to prepare this recommendation is nearly fifteen years old (1992 statewide waste audit). Local waste streams may differ significantly from the state average. Waste audits should be implemented using a common scenario with state funding in 2008 and 2009.

Additional crucial early steps:

- Full implementation of Washington's Beyond Waste Plan's current action items.
- Incorporate GHG reduction analysis and strategies in Beyond Waste Plan updates and next phase strategies.
- Fully implement and improve Washington State's Environmentally Preferable Procurement program and policies.

Legislative and budget proposals should be developed for the 2009 Legislature and a report and recommendations provided to the appropriate committees annually thereafter, until the goals are attained.

Specific details are provided below:

1. Local waste audits
    - development of statewide system model
    - development of statewide funding
    - implement audit
    - use results to influence local GHG reduction programs

2. Evaluate use of a model and index to measure and monitor GHG reductions
    - the EPA's WARM model was used for policy development
    - WARM model has some gaps, notably in failing to calculate source reduction potential for yard waste and food waste and it doesn't consider all the materials that are being recycled.
    - Investigate applicability or tweaks necessary to account for the actual types and location of disposal facilities in Washington State.[6]
    - Implement and evaluate use of the Washington State Consumer Environmental Index (CEI). CEI tracks changes over time in the environmental emissions and their impacts caused by the production, use and disposal of items purchased each year by Washington's consumers.

[6] Given varying distances to transport waste and recyclables, using average distances and population "centroids" (as was used for the estimates in the current run of the WARM model) may not be the most accurate for program implementation

3. Build on existing source reduction and recycling programs, targeting commodities with the largest GHG reduction potential.

4. Fully implement and update Washington's Beyond Waste Plan. The current 5-year milestones and action items include key initiatives to increase recycling of industrial waste and organic materials, expand green building, reduce toxics and increase the ability to recycle products, and more. The next update and related funding priorities should further incorporate GHG emissions analysis and GHG reduction actions.

5. Fully implement and expand Environmentally Preferable Procurement policies and programs by the State and local governments.

6. Encourage manufacturers to provide – and consumers to use – end of life management and upstream design solutions that reduce the green house gas and other environmental impacts of product waste. Develop a framework policy for establishing product stewardship programs.

7. Encourage large retailers (e.g. Wal-Mart) to leverage buying power to encourage manufacturers to make the design solutions that reduce GHG and environmental impacts of product waste.

8. Establish a research and educational institute to address sustainable product design and manufacturing.

9. Ecology, CTED, Health and other appropriate agencies should coordinate reporting to the appropriate committees of the legislature, on an annual basis, progress made in reaching the goals and recommendations for legislation or other actions by the state.

10. Form an on-going technical work group of experts on reduction, reuse, recycling, composting, product stewardship and green business development to advise Ecology, CTED, Health and other appropriate agencies on actions needed to implement this action item and attain the policy goals. This could be accomplished by restructuring the Washington Solid Waste Advisory Committee (SWAC), creating a sub-committee of SWAC, or by creating an entirely new group. The technical work group's recommendations will be considered when reporting progress, next steps and recommendations to the legislature.

Related Policies/Programs in Place

This section identifies (and provides links to) some of the "foundational" policies and programs that are already in place supportive of our proposal.

1. **Washington RCW 70.95** establishes solid waste hierarchy of reduce/reuse/recycle and requires all local governments to have a solid waste management plan. http://apps.leg.wa.gov/RCW/default.aspx?cite=70.95

2. **Washington Department of Ecology Beyond Waste Plan**: http://www.ecy.wa.gov/beyondwaste/

- Solid Waste Initiative, http://www.ecy.wa.gov/beyondwaste/SWIssues.html.
- Hazardous Waste Initiative, http://www.ecy.wa.gov/beyondwaste/HazWasteIssues.html
- Small Volume Toxics Initiative, http://www.ecy.wa.gov/beyondwaste/reduceToxics.html
- Organics Initiative, http://www.ecy.wa.gov/beyondwaste/increaseOrganics.html.
- Industrial Waste Initiative, http://www.ecy.wa.gov/beyondwaste/reduceWaste.html.
- Green Building Initiative, http://www.ecy.wa.gov/beyondwaste/increaseGB.html.
- Measure Progress, http://www.ecy.wa.gov/beyondwaste/measureProgress.html

3. **Electronic Product Recycling Program**: Manufacturers required to provide recycling for covered electronics. http://www.ecy.wa.gov/pubs/wac173900.pdf.

4. **Ecology Coordinated Prevention Grants:** Available to local governments to develop and implement their hazardous and solid waste management plans. http://www.ecy.wa.gov/programs/swfa/grants/cpg.html.

5. **Ecology Public Participation Grants:** Public Participation Grants provide funding to citizen groups and not-for-profit public interest organizations to provide public involvement in monitoring the cleanup of contaminated sites and prevent pollution by reducing or eliminating waste at the source. http://www.ecy.wa.gov/programs/swfa/grants/ppg.html.

6. **Washington State Environmentally Preferable Purchasing Policies:** The State of Washington has a broad legislative and policy mandate for environmentally preferable purchasing activities by state agencies. This mandate is articulated in state executive orders, laws and rules. Executive Orders (EOs) are issued by the Governor to direct state agencies and officials in their execution of established laws or policies. The Revised Code of Washington (RCW) is the compilation of all permanent laws now in force in the State of Washington. The Washington Administrative Code (WAC) is the compilation of all rules promulgated by state agencies.

   A brief summary of environmentally preferable purchasing executive orders, laws and rules for state agencies is listed below. For more information on specific activities or directives contained within each order, law or rule, follow the link provided.

   Executive Order 02-03 SUSTAINABLE PRACTICES BY STATE AGENCIES
   This Executive Order calls for each state agency to establish sustainability objectives and modify their purchasing practices in order to:

   - minimize energy and water use
   - shift to clean energy for both facilities and vehicles
   - shift to non-toxic, recycled and remanufactured materials in purchasing and construction
   - expand markets for environmentally preferable products and services

- reduce and eliminate waste

Each agency is required to prepare a biennial Sustainability Plan guided by the above objectives and an annual report on its progress in implementing its Sustainability Plan. The Office of Financial Management must designate a Sustainability Coordinator to help state agencies meet the goals of the Executive Order.

Executive Order 05-01 ESTABLISHING SUSTAINABILITY AND EFFICIENCY GOALS FOR STATE OPERATIONS
The Executive Order directs state agencies to achieve specific sustainability goals and required actions:

- incorporate green building practices based on Leadership in Energy and Environmental Design (LEED) standards into new building construction and major remodeling projects
- achieve a target of 20% reduction in petroleum use in the operation of state vehicles by 2009
- employ professional vehicle fleet management practices to achieve more fuel efficient and low emission agency fleets
- significantly reduce office paper purchases by 30%, increase the purchase of environmentally preferable paper to at least 50%, recycle all used office paper, and increase the purchase of post-consumer recycled janitorial products
- reduce energy purchases by 10% from FY 2003 to 2009

Executive Order 04-01 PERSISTENT TOXIC CHEMICALS
The Executive Order directs state agencies to take steps to reduce persistent toxic chemicals in Washington State's environment. Specifically, it directs:

- General Administration (GA) to make available for purchase products that do not contain persistent toxic chemicals. If such products are not available, products with the least amount of persistent toxic chemicals shall be made available.
- Each state agency to adopt measures to reduce purchase of goods that contain persistent toxic chemicals. Agencies are directed to report annually on progress in meeting these measures.
- Department of Ecology to establish through rule specific criteria for use in identifying persistent toxic chemicals.

Executive Order 07-02 Washington Climate Change Challenge:
the Executive Order establishes the goal of reducing greenhouse gas emission in the state of Washington to:

- 1990 levels by 2020 and to 25% below 1990 levels by 2035.

Chapter 43.19 RCW Department of General Administration
This statute, which is GA's enabling legislation, provides a broad legislative basis for state purchases of recycled content and energy saving products. It also provides the

flexibility to allow GA to award state contracts based on environmental considerations. It establishes that factors beyond price, including past performance and life cycle costing, are to be used in determining the "lowest responsible bidder."

Chapter 43.19A RCW Recycled product procurement
This statute was established to substantially increase the purchase of recycled content products by local and state government agencies. This statute

- established numeric goals for statewide purchase of recycled content paper and compost
- directs GA to develop a strategy for state agencies and GA to increase purchases of plastic products, retread and remanufactured tires, motor vehicles, lubricants, latex paint and lead acid batteries having recycled content.

Chapter 43.19.539 RCW Purchase of Electronic Products Meeting Environmental Criteria
This statute requires the Department of General Administration to

- establish purchasing and procurement policies that establish a preference for electronic products that meet environmental performance standards relating to the reduction or elimination of hazardous materials.
- ensure that their surplus electronic products, other than those sold individually to private citizens, are managed only by registered transporters and by processors meeting the requirements of RCW 70.95N.250.
- ensure that their surplus electronic products are directed to legal secondary materials markets by requiring a chain of custody record that documents to whom the products were initially delivered through to the end use manufacturer.

Chapter 39.35D RCW High-performance public buildings
Green Buildings
State-owned buildings and schools shall adopt recognized standards for high-performance public buildings and allowing flexible methods and choices in how to achieve those standards. Public agencies and school districts shall document costs and savings to monitor this program and ensure that economic, community, and environmental goals are achieved each year.

Chapter 70.95M RCW Mercury Education Reduction Act
Mercury Education Reduction Act
The Mercury Education Reduction Act (MERA) mandates General Administration to give priority and preference to the purchase of equipment, supplies, and other products that contain no mercury-added compounds or components.

WAC 236-48-096 Bid Award Preference
Washington Administrative Code 236-48-096 establishes a bid award preference for recycled products. When determining the lowest responsive bid, bids for goods certified as recycled are to be given a preference of 10% of the amount of the bid.

7. **Local governments:** Local governments have instituted plans and a wide range of programs and policies to establish reduction, reuse, recycling, and composting activities, to increase procurement of environmentally preferable products, and to ban specific materials from disposal. Program information is shared through a variety of means including Recycling Coordinator meetings, Solid Waste Policy Forum, and the State Solid Waste Advisory Committee. Product stewardship efforts are coordinated through the Northwest Product Stewardship Council. http://www.productstewardship.net/

8. **Businesses:** Many businesses have instituted internal policies to address waste and recycling and some have begun to implement product stewardship programs. Washington has many businesses engaged in the business of reuse, recycling, composting, and processing, including reuse organizations such as Goodwill, and businesses that refurbish electronic equipment and resell building materials. Other businesses incorporate recycled content into their products. Green building activities are coordinated by a variety of business interests including the Built Green program of Master Builders and the Cascadia Green Building Coalition, and others.

9. **Non-Governmental Organizations**: A variety of NGOS have internal policies and work on implementation and coordination of policies and programs. These include Washington Citizens for Resource Conservation, Washington State Recycling Association, Washington Organic Recycling Council, Washington Toxics Coalition, Pollution Prevention Resource Center, and others.

Types(s) of GHG Reductions

CH_4: Methane reductions from avoided emissions from waste placed into landfills.

CO_2: CO_2 reductions from lower energy consumption associated with a reduction of wastes generated (e.g. energy used to create products or packaging). Also included are GHG reductions from lower energy consumption associated with utilizing recycled materials for production versus virgin materials.

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

GHG Reductions ($MMtCO_2e$) in 2012, 2020: 1.30. 4.76

Net Cost ($/$MtCO_2e$): **-**$(12.10)

- **Data Sources:** The 2005 baseline waste generation and diversion rates were provided by the AW TWG.[7] These data are derived from the 1992 Washington State Waste Characterization Study, [8] 2005 disposal data,[9] and the 2005 Recycling and Diversion Report.[10] The GHG

[7] S. Jackson and S. Wamback. Personal communication with K. Bickel and S. Roe. Forwarded to B. Strode via e-mail on September 11, 2007.

[8] 1992 Waste Characterization Study. Washington State Department of Ecology. Accessed on Sept. 18, 2007 from http://www.ecy.wa.gov/programs/swfa/solidwastedata/waste.asp.

[9] 2005 Solid Waste Disposal Data, by Facility. Washington State Department of Ecology. http://www.ecy.wa.gov/programs/swfa/solidwastedata/disposal/05facilitytypes.xls.

reductions are estimated using the US EPA Waste Reduction Model (WARM).[11] The data used to establish the cost effectiveness of the goals presented in this option are supported by the personal and professional project planning and program development experience of the AW TWG.

- **Quantification Methods:**

GHG Reductions

The 2005 baseline generation and diversion was derived through an extrapolation of diversion rates from the 1992 Waste Characterization Audit to the 2005 disposal data. Information from the 2005 Recycling and Diversion Data report was also incorporated into these data.[12] For the purposes of this analysis, the only waste that is considered to be "generated" is waste composed of materials that may be analyzed with the EPA WARM. Waste combustion is utilized for the management of approximately 6% of non-diverted waste in WA. The share of non-diverted waste that is combusted is assumed to remain constant throughout the policy period. These figures include waste exported to landfills in Eastern Oregon. Although these emissions are not considered in the WA I&F, the reductions from reduced export of waste are counted in this analysis. The 2005 baseline diversion data is displayed in the table below:

2005 Baseline Waste Generation and Diversion (tons)

	Generated	Recycled	Landfilled	Combusted	Composted	Recycle and Compost %
Aluminum Cans	46,208	15,441	29,013	1,754	0	33.42%
Steel Cans	86,014	12,133	69,670	4,211	-	14.11%
Glass	315,310	82,773	219,282	13,255	-	26.25%
HDPE	45,870	9,319	34,468	2,083	-	20.32%
LDPE	17,830	16,209	1,529	92	-	90.91%
PET	26,435	8,534	16,881	1,020	-	32.28%
Corrugated Cardboard	933,811	565,698	347,131	20,982	-	60.58%
Newspaper	460,154	259,157	189,540	11,457	-	56.32%
Office Paper	132,976	58,661	70,079	4,236	-	44.11%
Food Scraps	720,615	-	561,297	33,928	125,390	17.40%
Yard Trimmings	886,928	-	367,255	22,199	497,474	56.09%

[10] Solid Waste in Washington State: Fifteenth Annual Status Report. 2006. Washington Department of Ecology. http://www.ecy.wa.gov/pubs/0607024.pdf.

[11] Links to WARM documentation, a list of material types recognized by WARM, and User's Guides for WARM can be found on the EPA website at http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsWasteWARMUsersGuide.html.

[12] The 2005 BAU diversion data was calculated by S. Jackson and S. Wamback; AW TWG members.

	Generated	Recycled	Landfilled	Combusted	Composted	Recycle and Compost %
Mixed Paper (general)	1,177,563	327,261	801,835	48,467	-	27.79%
Mixed Metals	1,376,520	1,144,327	218,958	13,235	-	83.13%
Mixed Plastics	456,920	7,734	423,582	25,604	-	1.69%
Mixed Organics	486,746		230,638	13,941	242,167	49.75%
Total	**7,169,900**	**2,507,247**	**3,581,158**	**216,464**	**865,031**	

The volume of waste generated in each year is assumed to grow at the same rate as the population. The projected population growth in WA is consistent with the projections used in the WA Inventory and Forecast (I&F). Based on this projection, the population is expected to increase by 13.13% from 2005 to 2012, and 10.42% from 2012 to 2020. The 2005 baseline waste generation was multiplied by the population growth rate from 2005 to 2012 to yield the BAU waste generation and diversion projections. The 2020 BAU waste generation was determined by multiplying the 2012 forecast by the expected population growth from 2012 to 2020 (10.42%).

The 2012 policy scenario represents an increase in diversion (recycling, composting, and source reduction) equal to 30% of the difference between the 2020 diversion goals and the BAU scenario. The 2020 policy scenario represents the estimated waste diversion should all policy targets be met. The source reduction goal is applied in full (15% of waste generated), given that the source reduction goal does not exceed the difference between waste generated and the compost or recycle goal.

Each scenario (4 total) was entered into WARM.[13] The difference between the policy scenario and BAU scenario GHG reduction is the incremental GHG emission reduction resulting from the targets set forth in this option. WARM does not allow input for source reduction for the following waste materials: food scraps, yard trimmings, mixed paper (general), mixed metals, mixed plastics, and mixed organics. This modeling barrier may be remedied by subtracting the source reduction from the "waste generated" and "tons landfilled" columns for the baseline worksheet in the policy scenario and entering the policy scenario as calculated above into the policy worksheet.

Incremental Waste Reduction (tons) and WARM Results

	Generated	Recycled	Composted	Source Reduced	Landfilled	Combusted	Diversion %	WARM GHG Benefit ($MtCO_2e$)
2012 BAU Scenario	8,111,308	2,836,449	978,610	-	4,051,364	244,886	47.03%	13,069,550

[13] For WARM documentation, visit the following link: http://yosemite.epa.gov/oar/globalwarming.nsf/content/ActionsWasteWARMUsersGuide.html.

	Generated	Recycled	Composted	Source Reduced	Landfilled	Combusted	Diversion %	WARM GHG Benefit ($MtCO_2e$)
2012 Policy Scenario	8,111,308	3,185,379	1,330,374	365,009	3,035,274	195,272	60.17%	14,365,507
2012 Incremental Diversion	**-**	**348,931**	**351,764**	**365,009**	**(1,016,089)**	**(49,615)**	**13%**	**1,295,957**
2020 BAU Scenario	8,956,506	3,132,006	1,080,581	-	4,473,516	270,403	47.03%	14,431,409
2020 Policy Scenario	8,956,506	4,416,304	2,375,308	1,059,572	1,038,511	66,812	87.66%	19,193,663
2020 Incremental Reduction	**-**	**1,284,297**	**1,294,727**	**1,059,572**	**(3,435,004)**	**(203,592)**	**37.91%**	**4,762,254**

Net Policy Cost[14]

This mitigation option requires a significant investment in human, social, and physical capital to implement. However, the reduction of total waste generated, as well as diversion mechanisms such as recycling and composting, present a significant potential for cost savings. The costs associated with this option are broken down into three categories: planning costs, implementation costs, and facility development and operation costs. The cost savings are attributed to the costs averted through the diversion of waste from landfills, as well as revenue generated by the sale of compost.

The planning costs for this option include a $1 per capita expenditure for a State-wide waste audit[15] and a $1 million cost for the development of a Washington State-specific waste reduction model to track the GHG benefits of the proposed diversion programs. These planning costs are assumed to be one-time costs that take place prior to the end of 2008. Therefore, the total cost for the waste audit program is based upon the 2008 population, as projected in the WA I&F. The total planning costs – annualized over the policy period at 5% interest – are approximately $860,000 per year through 2020.

The implementation costs include new education programs for waste reduction, as well as recycling and composting.[16] The implementation of this option is also expected to require the

[14] S. Jackson and S. Wamback. Personal communication with K. Bickel and S. Roe. Forwarded to B. Strode via e-mail on September 11, 2007.

[15] Based on similar characterization project conducted in Pierce County in 1995 and another planned for 2008

[16] This spending could be employed in a myriad of ways based on local conditions and targets. This could be a combination of staff working directly with local businesses and residents; brochures and newsletters; or other tools

establishment of a research and educational institute at a cost of $1.5 million per year. The two education programs are expected to cost $1 per capita annually. The total annual cost of these programs are based on the population projections used in the WA I&F. The implementation costs are displayed below, in tabular form:

Implementation Costs for Waste Diversion Programs

Year	Population	Waste Reduction Education ($MM)	New Recycling and Composting Education ($MM)	Research and Educational Institute ($MM)	Total Implementation Costs ($MM)
2008	6,630,676	$6.63	$6.63	$1.50	$14.76
2009	6,751,441	$6.75	$6.75	$1.50	$15.00
2010	6,865,990	$6.87	$6.87	$1.50	$15.23
2011	6,975,055	$6.98	$6.98	$1.50	$15.45
2012	7,077,871	$7.08	$7.08	$1.50	$15.66
2013	7,175,504	$7.18	$7.18	$1.50	$15.85
2014	7,270,759	$7.27	$7.27	$1.50	$16.04
2015	7,364,079	$7.36	$7.36	$1.50	$16.23
2016	7,455,272	$7.46	$7.46	$1.50	$16.41
2017	7,546,113	$7.55	$7.55	$1.50	$16.59
2018	7,636,476	$7.64	$7.64	$1.50	$16.77
2019	7,726,254	$7.73	$7.73	$1.50	$16.95
2020	7,815,252	$7.82	$7.82	$1.50	$17.13

The costs for facility development and operation include all costs associated with planning, developing, constructing, and maintaining new recycling, composting, or other diversion facilities. The cost for additional recycling and compost facilities required by the additional diversion proposed by this mitigation option is assumed to be $80 per ton (annually) of additional waste recycled or composted.[17] The total annual cost of facility development and operation is displayed below:

Incremental Facility Development and Operation Costs

Year	Incremental Tons Composted	Incremental Tons Recycled	Compost Facility Cost ($MM)	Recycling Facility Cost ($MM)	Total Additional Facility Cost ($MM)
2008	-	-	$0.00	$0.00	$0.00
2009	87,941	87,233	$7.04	$6.98	$14.01
2010	175,882	174,465	$14.07	$13.96	$28.03
2011	263,823	261,698	$21.11	$20.94	$42.04
2012	351,764	348,931	$28.14	$27.91	$56.06
2013	469,635	465,851	$37.57	$37.27	$74.84

and information resources. Research institute information provided by Snohomish County and Department of Ecology.

[17] The costs associated with planning, developing, constructing, and maintaining new recycling, composting, or other diversion facilities are very soft at such an early stage of consideration. The work group suggests $50 per ton as a starting point based on experiences in Pierce County. Based on CCS experience from other processes, $80 per ton appears to be a more conservative cost estimate.

Year	Incremental Tons Composted	Incremental Tons Recycled	Compost Facility Cost ($MM)	Recycling Facility Cost ($MM)	Total Additional Facility Cost ($MM)
2014	587,505	582,772	$47.00	$46.62	$93.62
2015	705,375	699,693	$56.43	$55.98	$112.41
2016	823,246	816,614	$65.86	$65.33	$131.19
2017	941,116	933,535	$75.29	$74.68	$149.97
2018	1,058,986	1,050,456	$84.72	$84.04	$168.76
2019	1,176,857	1,167,376	$94.15	$93.39	$187.54
2020	1,294,727	1,284,297	$103.58	$102.74	$206.32

The cost savings accrued through the programs proposed in this mitigation option include net cost savings generated through source reduction, composting, and recycling. Source reduction leads to a direct cost savings, due to the avoided MSW collection and disposal cost.[18] The cost savings accrued through increased composting includes the net cost of disposal at a compost facility (relative to landfill disposal), as well as the revenue generated through the sale of compost. The landfill collection disposal cost is assumed to escalate annually at a rate of 2.4%. The cost of collection and disposal of compost is assumed to increase at the same rate as garbage (MSW). The value of compost in the State of Washington is assumed to be $12.00[19] per ton. The savings realized through recycling programs include the relative cost of sending the waste to a recycling facility, as opposed to a landfill. The cost savings from each diversion technique is calculated by multiplying the tons managed in each year by the difference between the net cost of traditional (landfill) management and alternative (recycling and composting) management. This difference is assumed to remain constant throughout the policy period, as the cost of management for each approach is assumed to increase at the same rate (2.4%).[20] The tables below display the per-ton collection and disposal costs for each waste management technique, as well as the estimated cost savings that result from the programs detailed in this mitigation option.

Per-ton Collection and Disposal Costs[21]

	Collection Cost ($/ton)	Disposal Cost ($/ton)	Net Cost ($/ton)
Landfill Disposal	$71.00	$99.00	$170.00
Recycling	$179.00	($69.00)	$110.00
Composting	$82.00	$60.00	$142.00

[18] Recent analysis shows that the statewide median fee is $73 per ton. Studies of waste prevention of non-hazardous manufactured goods (not home composting) have estimated that the avoided procurement benefits, per-ton of waste prevention are at least 10 times larger (and sometimes 50 – 100 times larger) than the avoided disposal benefits.[18] This could push the "net net" well into cost savings territory.

[19] Personal communication between S. Wamback and B. Strode; September 21, 2007. This estimate is corroborated by "Compost Materials Market Assessment" by D. Long and A. Jackson. Report prepared on November 18, 2002 for Whatcom County Dairy Biogas Initiative.

[20] This assumption is conservative, as the AW TWG feels that it is likely that the cost of recycling and composting management could decrease with scale. However, the costs of these management techniques are heavily reliant upon strong markets for recycled material and compost. An influx of such material may inhibit increasing returns to scale.

[21] Collection and disposal costs for Pierce County. Personal communication between S. Wamback and B. Strode; September 21, 2007.

Incremental Cost Savings Due to Increased Source Reduction, Recycling, and Composting

Year	Incremental Tons Source Reduced	Landfill Net Cost Fee ($/ton)	Compost Value ($/dry ton)	Recycling Savings ($MM)	Compost Savings ($MM)	Source Reduction Savings ($MM)	Total Incremental Policy Savings ($MM)
2008	0	$170.00	$12.00	$0.00	$0.00	$0.00	$0.00
2009	91,252	$171.02	$12.00	$5.23	$3.52	$15.61	$24.36
2010	182,504	$172.05	$12.00	$10.47	$7.04	$31.40	$48.90
2011	273,757	$173.07	$12.00	$15.70	$10.55	$47.38	$73.63
2012	365,009	$174.10	$12.00	$20.94	$14.07	$63.55	$98.55
2013	451,829	$175.12	$12.00	$27.95	$18.79	$79.12	$125.86
2014	538,650	$176.14	$12.00	$34.97	$23.50	$94.88	$153.35
2015	625,470	$177.17	$12.00	$41.98	$28.22	$110.81	$181.01
2016	712,290	$178.19	$12.00	$49.00	$32.93	$126.92	$208.85
2017	799,111	$179.22	$12.00	$56.01	$37.64	$143.21	$236.87
2018	885,931	$180.24	$12.00	$63.03	$42.36	$159.68	$265.07
2019	972,751	$181.26	$12.00	$70.04	$47.07	$176.32	$293.44
2020	1,059,572	$182.29	$12.00	$77.06	$51.79	$193.15	$321.99

The discounted and levelized cost effectiveness of this mitigation option was determined by calculating the net present value (NPV) of the net cost of the mitigation option (the sum of planning, implementation, and facility development cost less cost savings). The estimated cumulative avoided emissions from this mitigation option are 29.21 $MMtCO_2e$. The NPV of the net option costs is estimated to be -$353 million, resulting in a cost effectiveness of -$12.10/ $MtCO_2e$.

Summary of Benefits and Costs

Year	Avoided Emissions (MMtCO2e)	Annualized Costs (MM$)	Discounted Costs (MM$)	Levelized & Discounted Cost Effectiveness
2008	0.00	$15.62	$15.62	
2009	0.32	$5.52	$5.26	
2010	0.65	-$4.78	-$4.34	
2011	0.97	-$15.28	-$13.20	
2012	1.30	-$25.98	-$21.37	
2013	1.73	-$34.31	-$26.88	
2014	2.16	-$42.82	-$31.95	
2015	2.60	-$51.52	-$36.61	
2016	3.03	-$60.39	-$40.87	
2017	3.46	-$69.44	-$44.76	
2018	3.90	-$78.68	-$48.30	
2019	4.33	-$88.09	-$51.50	
2020	4.76	-$97.68	-$54.39	**$ (12.10)**
Totals	**29.21**	**-$547.83**	**-$353**	

- **Key Assumptions:** In addition to the assumptions listed in the above documentation, it is important to note that this analysis applies only to recyclable/compostable waste materials that are potential inputs in the EPA Waste Reduction Model. Including all MSW in the analysis would likely increase the GHG reductions, assuming that all non-recyclable/compostable waste is source reduced at 15% as well. The analysis also considers only waste managed in the State of Washington. Uncontrolled waste management (i.e. backyard burning, illegal dumping) is not accounted for.

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation:**
- **Reduced Fuel Import Expenditures:**

Key Uncertainties

[Insert text here]

Additional Benefits and Costs

[Insert text here]

Feasibility Issues

[Insert text here]

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

AW-4. Agricultural Carbon Management

Mitigation Option Description

Vegetation and soils represent a substantial global pool of stored carbon at more than 2,000 Gt (billion tons) of carbon. Human activities have severely depleted carbon levels in these terrestrial pools releasing that carbon to the atmosphere. For instance, most agriculturally cultivated soils have lost at least 50% of the native carbon to the atmosphere. Changes in management in terrestrial systems can "restore" some of the lost carbon to soils and vegetation.

Agriculture carbon sequestration uses agricultural crops and acreage to store carbon in biomass and soils. Management functions that affect agricultural carbon storage include (1) biomass production / inputs, (2) residue management, and (3) soil disturbance. Increased biomass inputs (either through production, translocation, or residue management strategies) coupled with reduced disturbance will lead to increased soil carbon storage. Low biomass production, residue removal, and/or tillage reduce soil carbon storage. Existing, commercial management tools can affect each of these functions (positively and negatively).

In addition to human management activities, natural features such as precipitation patterns, soils, and temperature also affect the capacity of soils and vegetation to store carbon. The highly variable agro-climatic conditions in Washington State significantly impact the capacity of soils and vegetation to store carbon. Therefore, agricultural carbon management policies need to recognize variability across the landscape.

Mitigation Option Design

- **Goals:**
    - Increase soil carbon storage statewide in agricultural soils by implementation of proven and novel technologies, such as reduced tillage, cover cropping, increased perennial cropping, rotational grazing, managed grasslands, and alternatives to agricultural burning.
    - Increase diversion of organic residuals and wastes from all sources (including municipal wastes) for land application on agricultural soils.
    - Increase vegetative standing biomass in agriculture by 80,000 acres per year through the use of high biomass producing woody crops and perennial grasses sequestering.
    - Expand use of agricultural crops and residuals for bioproducts that sequester carbon (e.g. fiberboard from straw).
- **Timing:**

Soil carbon sequestration timing:

- Increase use of no-till / direct-seed farming practices in the dryland (high and intermediate rainfall zones) region of the state by an average of 100,000 acres /

year between 2010 and 2020 for a total of at least 1 million acres (total no-till acres will be ~ 25% of dryland acres).

- Increase use of high-residue farming (i.e. cover crops, no-till, etc.) practices in the irrigated region of the state by 30,000 acres / year between 2010 and 2020 for a total of at least 300,000 acres (25% of irrigated acres).
- Increase use of improved management on pasture / grassland / rangeland / Conservation Reserve Program lands throughout the state by an average of 300,000 acres / year between 2010 and 2020 for a total of at least 3 million acres (~35% of rangeland / pasture / grassland) by 2020.
- Increase use of high-biomass perennial crops (hybrid poplar, switchgrass, etc.) to increase soil carbon storage by an average of 20,000 acres / year beginning in 2016, for a total of 80,000 acres by 2020. This practice initiates later due to the need to have commercially viable cellulosic energy conversion technologies / markets in place.
- Consideration must be given for the maintenance (or offset) of existing soil carbon pools, such as orchards, riparian areas, and Conservation Reserve Program / Set-aside lands – most of which are affected by either markets or additional [state and federal] government programs.

Land Application of organic residuals:

- Re-direct the equivalent of an additional 0.8 million dry tons of raw organic residuals (equivalent to 1/3 of waste paper in Washington State) for land application to agriculture by 2020. These organic residuals could come in the form of raw, composted, anaerobically digested, or thermochemically converted materials.

Standing Biomass:

- Increase use of high-biomass perennial crops (hybrid poplar, switchgrass, etc.) to increase above-ground, vegetative carbon storage by an average of 20,000 acres / year beginning in 2016, for a total of 80,000 acres by 2020. This practice initiates later due to the need to have commercially viable cellulosic energy conversion technologies / markets in place. Credit for the above ground carbon storage of perennial crops may need to be transferred if the biomass is converted to energy or materials.
- Consideration must be given for the maintenance (or offset) of existing vegetative carbon pools, such as orchards, riparian areas, and Conservation Reserve Program / set-aside lands.

Use of biomass for bioproducts:

- Collection of crop residues / biomass crops from ~80,000 acres of high-yielding, irrigated land (approximately 30% of current irrigated wheat production) beginning ~2016 for sequestration in long-term materials storage (i.e. straw board, etc.). Note: Removal of crop residue will eliminate or reduce soil carbon sequestration – and therefore cannot be double credited and should be constrained to high-yielding farmland. Furthermore, removal of crop residues (and standing biomass) has implications for nutrient management.

- **Coverage of parties:** Washington State University, Conservation Districts, USDA Natural Resource Conservation Service, Washington State Department of Agriculture, Washington State Department of Ecology, private sector
- **Other:** There is additional potential to increase carbon sequestration through agriculture practices beyond what is explicitly stated in the goals above. However, there is not enough information currently available to fully develop policies in these areas: replace CO2 emitting practices with CO2 neutral practices in agriculture (e.g. generation of CO2 in greenhouses; crop drying); optimize carbon-cropping for the state's diverse bioregional specifications that reduction GHG emissions, sequester carbon, and allows a cash crop for farmer (e.g. food, fuel, or carbon crop); increase conversion of dryland acreage to irrigated acreage (this will increase carbon sequestration but will rely upon more water that may not be available due to existing water rights and potential reduction in hydro power, snowpack, and rainfall); organic cropping systems (additional research is needed to compare location-specific organic and conventional cropping systems for carbon sequestration using life cycle assessment techniques that include, but are not limited to, tractor/farm vehicle hours, fuel usage, source of any nutrient and pesticides, hauling of nutrients and pesticides and respective application rates, and energy use from processing/conversion of crops for next stage use).

Implementation Mechanisms

- Engage in certification standards to maximize access to carbon markets from in-state agriculture (e.g. Chicago Climate Exchange eligibility).
- Stable land resource programs that encourage long-term carbon sequestration on appropriate acreage.
- Encourage regionally specific rotational/perennial crops that increase carbon sequestration and hold potential for economic gains.
- Support existing USDA programs such as CRP, CSP, and EQIP to expand successful adoption by producers. Expand programs that reduce risk and transition barriers (e.g. no-till drill rentals through conservation districts). Support research to develop novel techniques such as perennial wheat, biochar, and agriculturally-derived bioproducts.
- Explore policies to expand grass-based livestock production in the state, particularly through marketing Washington grown grass fed meat products.
- Work with agricultural producers to test alternatives to burning of agricultural residuals (e.g. bioenergy or bioproduct utilization). Partner with Ecology program.
- Develop conversion processes for bioproducts that can utilize crops and residuals from the state. Work with businesses to start new enterprises using these materials. Incorporate bioproduct specifications into state contracts (e.g. straw board for construction, compost and mulch for highway projects). Test adaptability of new crops such as switchgrass, kenaf, and hybrid willow for expanding production of agricultural biomass for bioproducts.
- Develop validated tools for calculating carbon credits from agriculture.

Related Policies/Programs in Place

USDA farm programs – EQIP, CRP, CSP
WA Ag Pilots Project
WSU Center for Bioproducts and Bioenergy (operations not funded)

USDA STEEP program for direct seeding; PNDSA grower organization
WSU perennial wheat breeding program
USDA-ARS agroecosystems project
USDA-ARS/WSU bioenergy crops project
WSDA alternatives to agricultural burning program
Conservation District programs – rental of direct seed drills
King County and other land application of biosolids programs
WDOE Beyond Waste program, Agricultural Burning Alternatives program

1. **Northwest Natural Resource Group (WA), $200,000.00:** Promoting Small Landowner Access to Emerging Carbon Sequestration Markets through Forest Certification, Aggregation, and Market Development. http://www.nnrg.org/.
2. **Washington Department of Natural Resources (DNR)**: DNR and WESTCARB produced an inventory of terrestrial carbon sequestration opportunities in Washington State.

Types(s) of GHG Reductions

[TWG has begun to provide input]

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

[TWG has begun to provide input]

- **Data Sources:**
- **Quantification Methods:**
- **Key Assumptions:**

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation:**
- **Reduced Fuel Import Expenditures:** Bioproducts can offset use of fossil fuel feedstocks. Gasification to make biochar is a source of bioenergy. Direct seeding reduces on-farm energy use by decreasing tractor fuel consumption.

Key Uncertainties

- Washington State lags the nation, and the US lags many other nations, in adoption of direct seed systems. Some of this is due to production risks where continued research may help resolve current problems. Another issue is investment risk in purchasing the new equipment needed.
- Biochar is untested in the diversity of soils in the state, so it is unknown whether benefits described elsewhere will occur here. Production of biochar is dependent on availability and deployment of gasification technology, for which there is no clear standard or leader at this time.
- The price of transport fuel will dictate the economic feasibility of moving large volumes of agricultural residuals to the place of beneficial use.
- How will increasing temperatures counteract our efforts to store soil C?
- There are still many uncertainties about the impact of specific farming practices on GHG. For example, the recent article by Hamilton et al. (2007) illustrates the uncertainty as to

whether agricultural liming is a net source or sink for CO_2, with significant implications for the GHG impact of various farming systems.

Additional Benefits and Costs

- Direct seed can lead to increased water infiltration and reduced sandblasting of crops, increasing profits. It can also protect water quality from sediment and agrichemicals, and air quality from dust. Initially direct seed may cost more due to increased fertilizer and pesticide use, and higher potential for crop loss.
- Use of organic amendments for fertilizer and soil quality helps position a farm for certified organic production where there are currently substantial price premiums for many crops grown in the state. There is currently a shortage of organic hay, and growing this crop would provide a financial boost to growers and support the use of perennial crops that can sequester carbon.
- A new strawboard process from WSU could open the market for this product. Excess straw, some of which is currently burned, could go to this product and be sequestered for 20-50 yr (whatever one uses for the life of a building).

Feasibility Issues

- The uniqueness of the state's agricultural diversity and variability must be considered in any agriculture carbon policy. Any such policy must be based off of sound research of our state's agricultural land and crops, and consider bio-regional differences in any recommendations.
- Overall sustainability is an important criterion for considering trade offs in benefits. For example, irrigating previous dryland acres for the purpose of sequestrating carbon will require using more water
- More investment is needed to develop carbon storage validation tools for both policy and carbon market use. Without such tools, viable agriculture mitigation efforts will be difficult.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

AW-5. Agricultural Nutrient Management

Mitigation Option Description

Agricultural nutrients are critical to the sustainable production of food, fiber and energy – and in many cases a primary cost of agricultural production. Nutrients are derived from many sources including fossil fuels, mined materials and biological materials / fixation. Poor nutrient use efficiencies in agricultural systems, the consequence of biological, technological and management factors, lead to considerable losses of nutrients (especially nitrogen) to the environment. Agriculture is the primary source of nitrous oxide (N_2O) emissions in the US, a greenhouse gas > 300 times as potent as CO_2. In addition to N_2O emissions, reactive forms of nitrogen are lost to the environment as nitrates and ammonia. While these losses have negative environmental ramifications, they also represent significant financial consequences for farmers. Improving on-farm nutrient use efficiencies; alternative, biological sources of nutrients, and enhanced recovery / relocation of nutrients will substantially reduce ag-related greenhouse gas emissions, improved economic returns for farmers, and reduced fossil energy use.

This option seeks to reduce GHG emissions from nutrient use by implementing improved management on farms, which will lead to more efficient use of fertilizers. This more efficient use could lower N_2O emissions from crop soils and leaching, as well as emissions associated with the production, transport, and application of commercial fertilizers. *[Note the linkage to one of the goals under AW-1, where the products from anaerobic digester projects are to be targeted for use to offset commercial fertilizer use]*

Mitigation Option Design

- **Goals:**
  - Reduce CO_2 emissions associated with excess applications of natural gas derived nitrogen and mined phosphorous through implementation of farm nutrient management plans and soil testing by 10% statewide.
  - Reduce N_2O emissions and use of natural gas derived nitrogen by an average of 10% per acre in the dryland production regions through application of *precision agriculture* technologies which reduce both total N applied as well as reduced N_2O evolution from soils.
  - Reduce N_2O emissions and use of natural gas derived nitrogen and mined phosphorous through recovery of 50% of the nitrogen and phosphorous from 25% of existing sources of nutrient concentrated biomass, such as manure, by 2020.
  - Reduce CO_2 emissions associated with the use of natural gas derived nitrogen and mined phosphorous by redirecting 25% of Washington inventoried biomass-based nutrients to farms by 2020.
  - Reduce CO_2 emissions by 20% through displacement of natural gas derived nitrogen with the use of biologically fixed nitrogen practices on 250,000 acres by 2020.

- **Timing:**
  - Implement farm nutrient management planning and soil testing state-wide by 2012, reduce excess nutrient applications by 10% of total nitrogen applied by 2020.
  - Increase the number of acres using *precision nitrogen management* technologies by 250,000 acres per year until 2020
  - Redirect an additional 2.5% per year of biomass-derived nutrients to farms until 2020.
- **Coverage of parties:** WSU, WSDA, Ecology, Conservation Districts, EPA, Private Sector
- **Other:**

Implementation Mechanisms

- Complete a geographic inventory of biomass nutrient sources and ag nutrient demand for Washington State.
- Complete an inventory of biomass nutrient sources and ag nutrient demand by 2010.
- Continue research, development and commercialization for biological nutrient recovery technologies.
- Increase biological fixation of nitrogen through the use of cover crops, intercropping of legumes, and research, development and commercialization of microbial nitrogen fixation.

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

TBD

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

- **Data Sources:**
- **Quantification Methods:**
- **Key Assumptions:**

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation:**
- **Reduced Fuel Import Expenditures:**

Key Uncertainties

[Insert text here]

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

AW-6. Reductions In On-Farm Energy Use and Improvements in Energy Efficiency

Mitigation Option Description

It has been estimated that the US food system as a whole (i.e. seed to dinner table) consumes as much as 1/5th of the US energy supply. Furthermore, the food system is one of the few sectors that uses every type of energy product, from electricity and thermal energy to liquid fuel to refined fertilizer, chemical, and material products derived from fossil fuels. A large fraction of this energy consumption occurs on-farm through the material and fuel consumption needed to produce crops and livestock.

The policy aims to reduce on-farm energy use and associated GHG emissions through the application of energy efficiency measures or on-farm energy projects.

Mitigation Option Design

- **Goals:**
  - Reduce liquid fuel consumption by an average of 25% per acre through adoption of equipment, technologies and cropping system practices that reduce the number of "tractor trips" across a field.
  - Improve electrical and thermal energy use efficiencies in agricultural facilities by 10%.
  - Reduce use of irrigation-related energy use through adoption of water use efficiency technologies *and* improved cropping system practices by 10%.
  - Substitute "on-farm" renewable energy technologies (solar, wind, geothermal) for fossil-fuel derived electricity and thermal energy products by an estimated 10MW capacity by 2020.
- **Timing:**
  - Reduce liquid fuel consumption: increase use of no-till / direct-seed farming practices in the dryland (high and intermediate rainfall zones) region of the state by an average of 100,000 acres / year between 2010 and 2020 for a total of at least 1 million acres (total no-till acres will be ~ 25% of dryland acres).\
  - Reduce liquid fuel consumption *and* irrigation-related energy use: increase use of high-residue farming (i.e. cover crops, no-till, etc.) practices in the irrigated region of the state by 30,000 acres / year between 2010 and 2020 for a total of at least 300,000 acres (25% of irrigated acres).
- **Coverage of parties:** WSDA, WSU College of Agriculture, Human and Natural Resources Sciences, WSU Extension Energy Program, Conservation Districts, Private Sector
- **Other:** *There is a significant amount of overlap between energy efficiency goals and goals in the ag carbon and ag nutrient management straw proposals. The same practices that can be employed for improving soil carbon sequestration or reducing nutrient use can be used to reduce ag energy use.

Implementation Mechanisms

- Complete an agriculture and food system energy use inventory for Washington state and identify key opportunities for systemic improvements in energy use.
- Reduce energy use in livestock production systems through the substitution of biologically-based technologies and practices.
- 2009-2010 – Complete ag energy use inventory for Washington State. Develop a strategic plan for implementation of case-specific energy efficiency strategies (i.e. facilities, etc.) and strategic systemic changes for improving food system use efficiencies.

Most energy inventories disaggregate food system related energy use and credit it to non-agricultural sectors (i.e. transportation, industrial, commercial, residential) making it difficult to evaluate systemic changes that could dramatically improve the energy efficiency of the food system. Efforts to improve the energy efficiency of agriculture need to combine case-specific changes in practices / technology with a systemic evaluation and inventory of agriculture and food system energy use.

Related Policies/Programs in Place

TBD

Types(s) of GHG Reductions

TBD

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

- **Data Sources:**
- **Quantification Methods:**
- **Key Assumptions:**

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation:**
- **Reduced Fuel Import Expenditures:**

Key Uncertainties

[Insert text here]

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

AW-7. Preserve Open Space/Agricultural Land

Mitigation Option Description

The Agriculture & Waste TWG recommends that Washington vigorously implement programs to reduce the rate at which agricultural lands are converted to developed uses, while protecting property rights and responsibilities. By protecting agricultural areas from development, the carbon in above-ground biomass and below-ground soil organic carbon can be maintained and additional emissions of CO2e to the atmosphere can be avoided. It is estimated that approximately 23,000 acres of Washington farmland are converted out of agriculture every year (USDA, 1997 Natural Resource Inventory), contributing significant CO2e emissions through the loss of stored carbon in biomass. Conservation of the agricultural land base can occur through a variety of planning, regulatory, market development, and incentive-based strategies. Conservation of the agricultural *land base* complements and supports the carbon management *farming practices* addressed in AW – 4. This option also supports the smart growth policies under options RCI-13 and T-4.

Mitigation Option Design

- **Goals:** The rate at which existing crop and rangelands are converted to developed uses should be reduced. By 2010, agricultural land conversion should be reduced by 30%. By 2020, the rate at which agricultural land is converted should be reduced by 50%.
- **Timing:** By 2010, agricultural land conversion should be reduced by 30%. By 2020, the rate at which agricultural land is converted should be reduced by 50%.
- **Coverage of parties:** Landowners, local governments, relevant state agencies, and non-governmental organizations, Western Climate Initiative.
- **Other:** WA farmland urbanization rate based on NRI = 23,000 acres/yr 1992-1997.
  - By 2020, achieving these goals would save **** acres of land per year from being converted to developed uses. This would retain the above- and below-ground carbon on these lands, as well as the carbon sequestration potential of these lands. Achieving these goals in conjunction with smart growth policies (Options RCI-13 and T-4) may also contribute toward a reduction in transportation emissions through more efficient development and lower vehicle use.

Implementation Mechanisms

- Ensure that any new regional (Western Climate Initiative) or federal cap and trade program allows offsets or trading of verified credits from forestry or agricultural carbon sequestration projects.
- Support the implementation of a vigorous new farmland protection program within the Office of Farmland Preservation. This program should include:
  - Significant new funding for a state-wide program to purchase agricultural easements
  - Economic development assistance to help keep agriculture profitable
  - Environmental compliance/stewardship assistance for farmers (e.g. through

programs such as CREP, Pioneers in Conservation, etc.)
- Increase funding for the Washington Wildlife and Recreation Program, which protects open space and agricultural lands.
- Encourage the expansion and development of Transfer of Development Rights (TDR) programs that use market-based mechanisms to protect the agricultural land base.
- Encourage local governments to establish local funding mechanisms to conserve agricultural land. (e.g., the King County Farmland Preservation Program and the Skagit County Farmland Legacy Program).
- Engage in certification standards to maximize access to voluntary carbon markets from in-state agriculture (e.g. Chicago Climate Exchange eligibility).
- Implement programs that encourage long-term carbon sequestration on appropriate acreage (specific programs addressed through AW – 4).
- Support certification programs that enlist consumer support for climate friendly farming practices.
- Adopt and implement an environmental mitigation policy that protects farmlands.

Related Policies/Programs in Place

A variety of programs and policies are in place to encourage the conservation of the agricultural land base. These include: agricultural zoning, current use taxation programs, right-to-farm ordinances, local purchase of development rights programs (e.g., the King County Farmland Preservation Program and the Skagit County Farmland Legacy Program), and the Washington Wildlife and Recreation Program (WWRP). During the current biennium, WWRP has funded over $9 million in projects to purchase development rights on agricultural lands throughout Washington state.

In addition, the 2007 Legislature created the Office of Farmland Preservation in the State Conservation Commission (Chapter 352, 2007 Laws PV). The legislation directs the Office of Farmland Preservation to:

- Recommend a funding level for a new agricultural easement purchase program
- Develop model programs and tools, including innovative economic incentives for landowners, to retain agricultural land for agricultural production
- Provide technical assistance to localities as they develop and implement programs, mechanisms, and tools to encourage the retention of agricultural lands
- Provide analysis and recommendations as to the continued development and implementation of the farm transition program
- Serve as a clearinghouse for incentive programs that would consolidate and disseminate information relating to conservation programs that are accessible to landowners and assist owners of agricultural lands to secure financial assistance to implement conservation easements and other projects.
- Develop a grant process and an eligibility certification process for localities to receive grants for local programs and tools to retain agricultural lands for agricultural production
- In cooperation with the Agricultural Preservation Task Force, analyze the major factors that have led to past declines in the amount and use of agricultural lands in Washington

and of the factors that will likely affect retention and economic viability of these lands into the future.

Related Policies/Programs in Place

Types(s) of GHG Reductions

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

- **Data Sources:**
- **Quantification Methods:**
- **Key Assumptions:**

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation:**
- **Reduced Fuel Import Expenditures:**

Key Uncertainties

[Insert text here]

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

AW-8: Support for an Integrated Regional Food System

Mitigation Option Description

16% of the U.S.'s total energy use is consumed within the national food system. A regional food system that integrates the whole supply chain (production, processing, packaging, distribution, purchase, preparation, and waste management) in carbon reduction strategies holds significant potential for reducing greenhouse gas emissions. Life cycle assessment research that includes traditionally externalized factor inputs - such as food production practices, transportation method (boat, truck, plane), type of vehicle fuel used in transportation - and addresses more than just food mile measurements, is the first goal and will help determine the actual size of ghg reduction.

A successful regional food system will also provide new markets for regional farms of varying sizes, create new jobs and markets for food and energy companies in state, reduce petroleum use, and strengthen rural communities through the retention and circulation of profits within the regional economy. Ultimately agricultural lands can be preserved since there are now more robust economic options for farmers, which can reduce the risk of farming as a source of financial debt concern.

Low carbon footprint food products improve air, soil and water quality, particularly when integrated with carbon, nutrient, and water management strategies as proposed in other AW TWG strategies. By supporting low carbon food products we support the production of low carbon farming practices, like the use of on-farm renewable energy systems; organic carbon sequestration method including low-till/no-till methods; and agricultural carbon, nutrient, and water management strategies.

A regionally vibrant food system should not penalize current import/export successes, especially those that are working to implement carbon reduction strategies. This policy provides incentives to import/export supply chains that meet our ghg emission goals by rewarding carbon reduction in their existing supply chains for any product that passes through Washington ports and has met stated ghg emission goals.

This option has cross benefits that complement some Transportation, Energy, and the Residential, Commercial, and Industrial TWG mitigation strategies, with potentially larger savings by utilizing low carbon fuel standard fuels, in-state biofuels, and/or for the co-location of renewable energy systems with regional food infrastructure requirements.

This option is focused on impacts and issues after farm production and complements AW TWG options that address farm production, solid waste, and open space and farmland preservation.

Overall, this policy is focused on looking across traditional issues and approaching the issues of ghg emission reduction, increasing clean energy jobs, and reducing fuel imports by integrating various issues, and whole supply chains, in to one cohesive strategy.

Mitigation Option Design

Goals:

- Quantify potential gains through life cycle assessments of current and relevant potential food products by Nov. 1, 2011.
  - Designed around agricultural products optimized for our diverse growing regions.
- Integrate mitigation with cross-sector strategies emerging from transportation, energy, and residential/commercial/industrial technical working groups by December 2007 [CCS notes the timing of this goal falls w/in this process? Please clarify]
- Increase in-state production, processing, packaging, distribution, demand, and availability of state food for state markets by 2015. Utilize regional food products when appropriate and/or feasible.
- Reduce by 20% by 2020 the transportation distance that individuals, particularly those with limited food choices, have to travel to purchase recommended food such as those included in federal dietary recommendations, partly by encouraging delivery services that minimize physical store trips.

Timing:

- Quantifying research of true potential by Nov. 1, 2009.
- State and local public institutions will lead by example by sourcing local food system products:
  - 15% voluntary increase in dollars spent for regionally sourced products by 2010.
  - 15% required increase in dollars spent for regionally sourced products by 2015.
  - 20% required increase in dollars spent for regionally sourced products by 2020.

Coverage of parties: State Department of Ecology, State Department of Community, Trade and Economic Development, State Department of Agriculture, private sector.

Other:

- Clean energy jobs will increase related to food processing, transportation, and waste disposal/composting. Some job shifting is expected to occur across the transportation, shipping, and retail sectors.
- Reduction in fuel imports will occur from incentivizing biofuel that is feasibly grown and processed in-state, in conjunction with the Low Carbon Fuel Standard. And as through meeting the low carbon fuel standard, production of biofuel feedstocks in-state will lead to more ghg reductions and sequestration within the agricultural sector.
- Tax revenue and community wealth will increase due to the retention/capturing of economic activity dollars in regional communities. New research on the economic benefits of locally directed spending shows that for every consumer dollar spent at community-based restaurants and groceries, more than 45 cents of additional economic

activity is generated as the spending circulates through the state economy[22]. Regionally-directed activity creates tax revenue that can be used to fund ghg reduction incentives.
- A carbon market mechanism or incentive that includes an economically attractive option for small and mid-size producers will generate an increase in economic activity, allowing public and private budgets to utilize precious resources for other items and needs. Money saved from this and other carbon-market related activity can be used to fund incentive packages that support the growth of this and other ghg reduction strategies.
- Food production waste that is sourced from organic and/or biostocks, including livestock manure, dairy waste, and organic municipal solid waste, may be a source of renewable energy for food processing facilities, or at least a viable feedstock for any biofuel or bioenergy processing facilities.
- Larger gains can be realized by co-locating biofuel and renewable energy facilities with food processing centers, and also through incentives to use biofuels for transportation of food ingredients and finished goods.
- Creation of in-state temporary construction as well as permanent maintenance jobs.

Implementation Mechanisms

- Determine the true potential for regional food system products and services to reduce ghg emissions, increase clean energy jobs, and reduce fuel imports. Complete research and submit findings by Nov. 1, 2011 [Nov 1, 2009?].
  - Research current and potential food products that in-state food system can produce.
  - Clarify growing regions of state to distinguish food product potential.
    - 7 regions: NW, SW, North Central (irrigated river valleys), North Columbia Basin (Project irrigated), South Columbia Basin (project irrigated), Yakima Valley (river irrigated), low-precip dryland*, intermediate precip dryland*, and high-rainfall dryland / annual crop zone* (Palouse).[23]
      - **The rainfall zones are west-east transitions, not north-south. They follow the Cascade rainshadow effect.*
  - Determine carbon content, using life cycle assessment methods, of current food products consumed in-state that have comparable in-state production potential, and of potential replacement food products that can be produced, processed, packaged, transported, stored, and/or sold in-state.
    - Include regional products (Oregon, Idaho, British Columbia) that show potential for large carbon reduction gains and/or large clean energy job creation.
    - Consider fuel and energy sources in calculations.
    - Ensure current low-carbon fuel or energy supplies, such as hydropower, are included.
    - Research costs of improving in-state freight rail service.

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[22] Based on the Sustainable Seattle report "Why Local Linkages Matter: Findings from the Local Food Economy Study", forthcoming October 2007

[23] *Chad Kruger, WSU*

  - Current and potential cost of production of any products determined to contain a lower carbon footprint.
    - Considers, where feasible, potential carbon-market mechanisms including, but not limited to, GHG (carbon) tax, GHG cap and trade, low carbon fuel standard.
- Integrate with cross-TWG straw proposals, including:
  - T-10: Incentives to Promote Low-GHG Vehicle Technologies;
  - T-11: Low Carbon Fuel Standard;
  - RCI-1.3: Business Energy Tax Credit;
  - RCI-6.1: Provide Incentives to Promote and Reduction of Barriers to Implementation of Renewable Energy Systems;
  - RCI-6.2: Provide Incentives and Resources to Promote and Reduction of Barrier to Implementation of Combined Heat and Power and Waste Heat Capture;
  - ES-2.3: Distributed renewable energy incentives and/or barrier removal;
  - ES-2.5: Combined Heat and Power (CHP) and Thermal Energy Recovery and Use;
  - ES-6.3: General distributed generation support
- Port fee incentive for any cargo vessel using bio-based fuels, especially if regionally produced, or that intentionally transports low-carbon food ingredients or products.
- All cafeterias in state agency buildings to increase their food offerings of state food system products by 15%, or of comparable food imports with a lower carbon footprint, when feasible until 2010, then a [absolute] 15% required increase by 2015 and a 20% required increase by 2020
  - Allocate up to fifteen cents per meal served to incorporate Washington agricultural products in to state agency cafeteria purchases and public school breakfast and lunch programs.
- Align state procurement regulations regarding in-state source preferencing.
- Encourage co-location of decentralized CHP and renewable energy facilities with food processing, production, and storage hubs.

Related Policies/Programs in Place

- Federal Incentives
- Washington State Incentives

Types(s) of GHG Reductions

TBD

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

- **Data Sources:**
  - "Washington State Fact Sheet", USDA Economic Research Service, *http://www.ers.usda.gov/statefacts/* , spreadsheet ("WA-fact-sheet.xls", and pdf downloaded Aug. 25, 2007)

- *Joydeep Ghosh and David W Holland, "The Role of Agriculture and Food Processing in the Washington Economy: An Input-Output Perspective", WSU, August 2004, http://www.impact.wsu.edu/publications/tech_papers/pdf/04-114.pdf*

- **Quantification Methods:**
- **Key Assumptions:**

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):**
- **Job Creation: [CCS notes text from "Other" could be moved or repeated here]**
- **Reduced Fuel Import Expenditures: [CCS notes text from "Other" could be moved or repeated here]**

Key Uncertainties

TBD

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD