Forestry Technical Work Group
Summary List of High Priority Mitigation Options

DRAFT

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2020 (Million $)	Cost-Effective-ness ($/$tCO_2e$)	Status of Option
		2012	2020	Total 2008-2020			
F-1	Improved Forest Health	1.2	1.7	16.8	11	0.63	In progress
F-2	Reduced Conversion to Nonforest Cover	2.2	9.2	53.3	TBD	TBD	In progress
F-3	Enhanced Carbon Sequestration in Forests						In progress
F-4	Enhanced Carbon Sequestration in Harvested Wood Products						In progress
F-5	Enhanced Carbon Sequestration in Harvested Wood Products						In progress
F-6	Expanded Use of Biomass Feedstocks for Electricity, Heat and Steam Production						In progress
F-7	Improved Commercialization of Advanced Lignocellulosic Processes						In progress
F-8	Urban and Community Forests						In progress
	Sector Total After Adjusting for Overlaps						
	Reductions From Recent Actions (table to be added below)						
	Sector Total Plus Recent Actions						

F-1. Improved Forest Health

Mitigation Option Description

Reduce catastrophic wildfire GHG emissions due to fuels buildup attributable to decades of fire suppression and related pest infestation and disease. Annually wildfire contributes at least 0.18 $MMTCO_2e$/yr, or 0.2% of the state total (Westcarb I, 2007*).

Implicit within this mitigation option is the recognition that:

- Wildfires play an important ecological function in the natural forest lifecycle yet millions of acres of Washington's forestlands are at uncharacteristic risk due to past management practices.
- Forests, depending on how they are managed, may be a net source or a net reservoir of CO2.
- Eastern and Western Washington have unique forestland types and related forest health challenges and should be treated differently.
- Implementation methods must be balanced and integrated with other policy options including those focused on carbon sequestration, biofuels and feedstocks, conversion and afforestation.

Through incentive and regulatory programs that reduce uncharacteristic wildfire this proposed option will promote hazardous fuel reduction in forests, and subsequent use of fuels in biomass power plants.

** This figure was the average for the years from 1990 through 1996, a period which preceded the larger fire seasons recently experienced. Current and projected emissions are likely to be significantly greater in the baseline case, and validation is needed for the methodology*

Mitigation Option Design

- **Goals:**
  - Reduce the rate of wildfire volatized GHG emissions through 50,000 acres/year reductions in forestland acres "at-risk" of catastrophic wildfire;
  - Restore 25% (500,000 acres) of Washington's "at-risk" state and private forestland, including 50% (XX** acres) in NE Washington, to a characteristically healthy state by the year 2020;
  - Restore 50% (1.0 million acres) Washington's "at-risk" state and private forestland to a characteristically healthy state by the year 2035;

- Restore all 2.0 million acres of Washington's "at risk" state and private forestland to a characteristically healthy state by the year 2050;

**waiting for E vs. W side statistics from DNR's Karen Ripley, or Dwayne Vaugen to fill in XX's*

- **Timing:** See goals above.
- **Coverage of parties:** Private forestland owners and managers, State-owned forest land managers, USDA Forest Service.
- **Other:** We recognize that this effort faces three classes of **limitations**:

1. Physical Limitations
    a. 35% slope or less
2. Economic Limitations
    a. Infrastructure
    b. markets
3. Policy Limitations
    a. influencing Federal lands
    b. Establishing a baseline
    c. Demonstrating additionality

While we **prioritize** recommendations focused on **thinning**, we do recognize all forms of "Forest Health Treatments" like prescribed burns, integrated pest management. We feel strategic thinning and similar treatments are most prudent in the climate policy context.

Do older trees with tight rings have more carbon?
We are also curious if there is any research on the Carbon sequestered in "dog hair" ponderosa pine—these older trees have very small diameters, and tight rings making them desirable lumber products—we are curious if there is an increased carbon per ton and a nexus with sequestration recommendations.

Implementation Mechanisms:

Jurisdiction of Implementation Mechanisms will cover private and state timberlands only, not Federal or Tribal.

Consideration will be given to opportunities to influence "forest health" on Federal Forestlands. Final recommendations should provide qualitative estimates for GHG reductions based on USFS adopting similar goals to reduce "at-risk" Federal forestland. While we **prioritize** recommendations focused on **thinning**, we do recognize all forms of "Forest Health Treatments" like prescribed burns, integrated pest management. We feel strategic thinning and similar treatments are most prudent in the climate policy context.

1. Enhanced Research and Information Dissemination*
    a. Education to landowners etc.
2. Technical Assistance*

   a. Pilot Projects
   b. Professional advise to land owner
   c. Modeling
3. Regulatory Forest Health Orders*
   a. For extreme risk situations
4. Financial Assistance
   a. For landowners to implement forest health treatments
5. Stimulate markets
   a. Seed demand for small diameter material through biomass and other markets
   b. Position forest health treatments to be sold as carbon credits in anticipated carbon cap and trade market
   c. Target areas that "pencil" in economic terms first to buy time for infrastructure and other economic limitations to be resolved
6. Public Works Project
   a. WA DNR gets into the business of improving forest health using savings from wildfire management season
7. Fire control protocols that reduce GHG emissions in fire fighting
8. Collaborative stakeholder planning processes
   a. E.g. NE WA Forestry Coalition developing consensus-based approaches to influencing policies on Federal Lands (Colville NF)

*Existing statutory authority, under way or under development but may benefit from additional resources/authority/incentives. Specifically, we recommend

- Maintaining or increasing base funding level for new forest health program at DNR.
- A broad range of pilot projects for silvicultural thinning regimes, evaluate these pilots and disseminate findings and appropriate models to landowners
- Establishing a strong staff/technical support presence in Eastern Washington

Related Policies/Programs in Place

DNR's Forest Health Program, RCW 76.06,
http://apps.leg.wa.gov/RCW/default.aspx?cite=76.06

as updated in 2007 with SSB 6141
http://www.leg.wa.gov/pub/billinfo/2007-08/Pdf/Bills/Session%20Law%202007/6141-S.SL.pdf

Types(s) of GHG Reductions

TBD

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

- **Data Sources:** WestCarb Report, "Carbon Sequestration through Changes in Land Use in Washington: Costs and Opportunities"
- **Quantification Methods:**
  - The option seeks to treat 50,000 acres per year for a total of 500,000 acres by 2020
  - Treatment will reduce the standing carbon stocks in the forest and reduce wildfire events
  - GHG reductions will depend on the fate of biomass that is removed and on how much fires are reduced
  - Analysis of reductions will be from 2008-2020
- **Key Assumptions:**
  - Accessible forest areas that are at moderate to high risk of fires will be targeted; according to WestCarb analysis there are about 2.3 million hectares (5.7 million acres), located mainly in the West and Northeast regions of the state.
  - Treatment will be consistent with CSCH (cut-skid-chip-haul of submerchantable biomass) (see table 4-1 of WestCarb); relatively low cost with high potential GHG reductions (according to WestCarb)
  - Biomass stocks of forests at moderate to high fire risk and accessible for CSCH treatment in WA are approximately 150 dry tons per acre.
  - CSCH removes 4-8 dry tons/ac
  - Biomass removed will be used for energy or will otherwise decay. In both cases, the carbon in removed biomass is emitted to the atmosphere. **Will the biomass regenerate?** If not, this is a permanent loss and should be counted as emissions (that's how the analysis is structured now).
  - Fuel reduction treatments will lead to avoided emissions associated with reduced wildfires; i.e., treatment results in low-intensity forest fires rather than medium-intensity fires with carbon reductions on the order of 8-30 t C/ha; or treatments result in low-intensity fires, rather than high-intensity fires with reductions of 16-80 t C/ha (WestCarb Baseline report cited as source).
  - CSCH costs $34-48/dry ton of biomass removed; this is offset by cost savings from sales to biomass facilities on the order of $36/dry ton (from WestCarb, original cited source: USDA Forest Service Research & Development/Western Forestry Leadership Coalition 2003); net costs are about $5/dry ton of biomass removed (i.e., $41-$36 per dry ton), using a mid-point value for implementation costs

Initial Results:

Summary of GHG Reductions Calculation

	Acres treated with CSCH	Biomass stock (dry tons)	Biomass removed (dry tons)	Emissions* (tons C)	Avoided emissions from reduced fires (tons C)	Net reductions (tons C)	Net reduction (MMtCO2e)
2008	7,143	1,071,429	42,857	-21,429	86,755	65,327	0.24

2009	14,286	1,071,429	85,714	-42,857	173,511	130,654	0.48
2010	21,429	1,071,429	128,571	-64,286	260,266	195,980	0.72
2011	28,571	1,071,429	171,429	-85,714	347,021	261,307	0.96
2012	35,714	1,071,429	214,286	-107,143	433,777	326,634	1.20
2013	42,857	1,071,429	257,143	-128,571	520,532	391,961	1.44
2014	50,000	1,071,429	300,000	-150,000	607,287	457,287	1.68
2015	50,000	1,071,429	300,000	-150,000	607,287	457,287	1.68
2016	50,000	1,071,429	300,000	-150,000	607,287	457,287	1.68
2017	50,000	1,071,429	300,000	-150,000	607,287	457,287	1.68
2018	50,000	1,071,429	300,000	-150,000	607,287	457,287	1.68
2019	50,000	1,071,429	300,000	-150,000	607,287	457,287	1.68
2020	50,000	1,071,429	300,000	-150,000	607,287	457,287	1.68
Total	500,000		3,000,000				16.77

*Assumes biomass removed is not replaced in the future

Summary of Costs

	Biomass removed (dry tons)	Emission reduction (MMtCO2e)	Net costs ($)	Discounted costs ($)*
2008	42,857	0.24	214,286	214,286
2009	85,714	0.48	428,571	408,163
2010	128,571	0.72	642,857	583,090
2011	171,429	0.96	857,143	740,432
2012	214,286	1.20	1,071,429	881,467
2013	257,143	1.44	1,285,714	1,007,391
2014	300,000	1.68	1,500,000	1,119,323
2015	300,000	1.68	1,500,000	1,066,022
2016	300,000	1.68	1,500,000	1,015,259
2017	300,000	1.68	1,500,000	966,913
2018	300,000	1.68	1,500,000	920,870
2019	300,000	1.68	1,500,000	877,019
2020	300,000	1.68	1,500,000	835,256
Total	3,000,000	16.77		10,635,492

*5% discount rate

Cost Effectiveness = NPV (sum of discounted costs) divided by cumulative GHG reductions
Cost Effectiveness = $0.63/ton CO2e

Additional Data from TWG:

"At risk" acreage according to DNR website

www.dnr.wa.gov/htdocs/rp/forhealth.html

Total acres at risk:

2003: 1.9 million acres;

2004: 1.9 million acres;

2005: 2.5 million acres;

2006: 2.0 million acres. (The reduction from 2005 to 2006 may in part reflect fires removing "at risk" areas.)

This is about 10% of the state's roughly 21 million acres of forest land. The percentage is likely to be much higher in eastern Washington.

Forest Health Strategy Work Group reports in 2004 and 2006.

"A Desirable Forest Health Program for Washington's Forests". December, 2004

http://www.dnr.wa.gov/htdocs/rp/forhealth/fhswgc/pdf/foresthealthreport.pdf

"Forest Health Strategy Work Group Report to the Legislature". December, 2006

http://www.dnr.wa.gov/htdocs/rp/forhealth/fhswgc/fhrepttolegdec06.pdf

Contribution to Other Goals

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

Key Uncertainties

We recognize that this effort faces three classes of **limitations**:

4. Physical Limitations
    a. 35% slope or less
5. Economic Limitations
    a. Infrastructure
    b. markets
6. Policy Limitations
    a. influencing Federal lands
    b. Establishing a baseline
    c. Demonstrating additionality

Additional Benefits and Costs

TBD

Feasibility Issues

TBD

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

F-2. Reduced Conversion to Nonforest Cover

Mitigation Option Description

Reduce conversion of forest lands to non-forest cover and to reduce the rate at which forested tracts are parceled and/or fragmented. The conversion of forestlands to other uses is a direct cause of carbon emissions due to the loss of biomass and soil disturbance. Non-forested areas contain lower amounts of biomass and associated carbon reserves. These areas also have less capacity to sequester carbon dioxide than forested areas.

Implicit within this mitigation option is the recognition that 1) forests, depending on how they are managed, may be a net source or a net reservoir of CO2 and 2) a continuous loss of forestland regardless of the rate will ultimately lead to loss of all forested land. This proposed option will promote the development of incentive programs that maintain forestland by reducing conversion and promoting forests' ability to continue to sequester carbon. This proposed option additionally aims to position Washington State forestland owners to participate in emerging carbon trading markets. This policy will include an analysis of population growth and its impact on forest land conversion and how incentives can minimize its impacts until an elimination of conversion is achieved. If these voluntary programs selected are not attaining the desired resolute, then it will be the responsibility of the state to increase or enhance the incentives so that landowners are providing the desired sequestration service.

Mitigation Option Design

- **Goals:**
    - Reduce the acres of forestland expected to be lost to non-forest uses by 70% by 2020.
- **Timing:** Policy initiation: by 2010 reduce expected loss by 10%, by 2020 reduce the expected loss by 70%.
- **Coverage of parties:**
- **Other:** It will take some time to develop and implement market initiatives and incentives programs that can stem the rate of conversion to non-forest use and for those reasons the 2010 goal is modest. But it is expected that with the full implementation of many of the mechanisms listed below dramatic decreases in the rate of conversion will be achieved. If these voluntary mechanisms are affective we hope to see an increase in forested land after 2030.
- Since the 1930's, Washington State has lost 2 million acres of timberland to other uses. But the trend has accelerated: over the next several years, 300,000 acres of Western Washington timberland is likely to be converted to other uses (Alig et al, 2003).

  Two demographic surveys conducted by Washington State University (WSU) and the Washington Farm Forestry Association also revealed that the average age of small forest

landowners is between 57 – 67 years old. These figures imply that a large percentage of this land base will change hands within a generation, likely leading to increased fragmentation and conversion.

Implementation Mechanisms:

- State level goals for maintaining overall forestland on public and private forestland acres.
- WA to participate in the development of a regional regulatory Cap and Trade system that recognizes forestry projects that could provide carbon sequestration offsets, including avoided deforestation of forestland.
- Encourage conservation easements used to maintain working forestland that are threatened with conversion
- The expansion and development of Transfer of Development Rights (TDR) a market based mechanism that promotes responsible growth, while conserving more sensitive areas such as our working forest lands.
- Implementation of the Rural Villages concept will provide an alternative to large lot development. Each rural village, a receiving site for development right transfers, will permanently protect working forests by transferring currently allowed development potential to compact developments.
- New tax incentives that encourage forest management for greater forest sequestration and avoid conversion.
- Changes to project environmental review requirements (e.g. SEPA) to require analysis and mitigation of climate impacts, including those related to possible depletion of forest carbon stocks.
- The state to provide more analysis to help identify rates of conversion on a county by county level and credit the amount of carbon associated with maintaining the forest land cover as a percentage of the rate of conversion in the area (see CA Forest Protocols as reference).

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:**
  - This option maintains forest land that would otherwise be converted to development, assuming current rates of forest conversion continue out into the future
  - Preventing forest conversion avoids CO_2 emissions that would result from a loss of biomass and soil carbon stocks, and it protects the sequestration capacity of forests.

- Separate estimates are made for the East- and Westside because of different underlying forest conversion trends, predominant forest species, and carbon densities between these regions.

- **Key Assumptions:**
  - Baseline rate of forest conversion to developed uses for Eastside is assumed to be 3,560/yr, or 0.07%/yr (NRI 1992-1997, non-federal land)
  - Baseline rate of forest conversion to developed uses for Westside is assumed to be 19,500/yr, or 0.25%/yr (NRI 1992-1997, non-federal land)
  - 53% of biomass carbon stocks are lost/emitted during conversion (Strong 1997)
  - 35% of soil carbon stocks are lost/emitted during conversion (Austin 2006)
  - Separate East- and Westside carbon densities (tons C/acre) for biomass and soils were calculated, using a weighted average by area and forest type for 65-yr old stands
  - Separate East- and Westside carbon sequestration rates (tons C/ac/yr) also calculated as a weighted average, based on average annual change in carbon stocks from 0 to 65 yr old stands.
  - Cost assumptions: TBD

Initial results

Weighted Average Carbon Stocks and Carbon Sequestration by Region

	Biomass Stocks (tons C/ac)	Soil Stocks (tons C/ac)	Carbon Sequestration (tons C/ac/yr)
Eastside	61.24	29.10	0.61
Westside	252.17	67.52	3.16

(Note: more details will be provided on the derivation of these numbers)

Eastside Carbon Savings Calculation

	Acres Protected	Avoided Emissions Biomass (tons C)	Avoided Emissions Soils (tons C)	Total Avoided Emissions (tons C)	Protected Sequestration Capacity (tons C)	Total (MMtCO2e)
2008	119	3,852	1,209	5,060	72	0.02
2009	237	7,703	2,418	10,121	216	0.04
2010	356	11,555	3,626	15,181	432	0.06
2011	427	13,866	4,352	18,218	690	0.07
2012	641	20,799	6,528	27,326	1,079	0.10
2013	854	27,732	8,704	36,435	1,597	0.14
2014	1,068	34,664	10,879	45,544	2,244	0.18
2015	1,282	41,597	13,055	54,653	3,021	0.21
2016	1,495	48,530	15,231	63,761	3,927	0.25
2017	1,709	55,463	17,407	72,870	4,962	0.29

2018	1,922	62,396	19,583	81,979	6,127	0.32
2019	2,136	69,329	21,759	91,088	7,422	0.36
2020	2,492	80,884	25,385	106,269	8,932	0.42
Total						2.45

Westside Carbon Savings Calculation

	Acres Protected	Avoided Emissions Biomass (tons C)	Avoided Emissions Soils (tons C)	Total Avoided Emissions (tons C)	Protected Sequestration Capacity (tons C)	Total (MMtCO2e)
2007	0					
2008	650	86,874	15,361	102,236	2,053	0.38
2009	1,300	173,748	30,723	204,471	6,159	0.77
2010	1,950	260,622	46,084	306,707	12,318	1.17
2011	2,340	312,747	55,301	368,048	19,708	1.42
2012	3,510	469,120	82,952	552,072	30,794	2.14
2013	4,680	625,493	110,603	736,096	45,575	2.87
2014	5,850	781,867	138,253	920,120	64,052	3.61
2015	7,020	938,240	165,904	1,104,144	86,224	4.36
2016	8,190	1,094,613	193,554	1,288,168	112,091	5.13
2017	9,360	1,250,987	221,205	1,472,192	141,653	5.92
2018	10,530	1,407,360	248,856	1,656,216	174,911	6.71
2019	11,700	1,563,733	276,506	1,840,240	211,864	7.52
2020	13,650	1,824,356	322,591	2,146,946	254,975	8.81
Total						50.82

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

F-3. Enhanced Carbon Sequestration in Forests

Mitigation Option Description

Washington forests have a significant role to play in decreasing net emissions of carbon dioxide (CO2) by removing CO2 from the atmosphere. Our forests are among the most productive in the world, and programs designed to encourage management of our forests for increased overall forest carbon stocks can be an important part of the state's climate action strategy. Special programmatic emphasis should be placed on opportunities to increase and maintain overall carbon storage in the most stable reservoirs in the forest environment, especially stems, roots, and soils.

This mitigation option is designed to promote the removal of additional CO2 from the atmosphere by increasing and maintaining overall carbon stocks in Washington forests relative to a "business as usual" baseline. Net storage of forest carbon is influenced by many factors, including the conversion of forests to non-forest uses, forest health, and the wood products manufacturing process. These and other important issues related to enhanced carbon sequestration in Washington forests are addressed in other forestry mitigation options. In addition, this mitigation option includes as a policy goal the preservation of our state's public and private working forests. In support of this goal, this proposed option aims to position our state's public and private working forests to participate in emerging carbon trading markets.

Mitigation Option Design

- **Goals:** Help position Washington forest landowners to participate meaningfully in emerging carbon markets by implementing programs and incentives which, together with emerging market opportunities, will increase absolute levels of sequestered carbon relative to the business as usual baseline in Washington forests (exclusive of Federal and Tribal forestlands) by 10% by 2020 and 40% by 2050.
- **Timing:**
- Undertake and complete analysis necessary to determine business as usual baseline by _____.
- Develop accounting protocols to measure absolute changes in overall carbon stocks by _____.
- Adopt legislation and rules necessary to implement programs and incentives for healthy, native forests that support environmental values by _____.
- **Coverage of parties:** Washington Governor; Washington Legislature; Executive Departments (e.g. Ecology, DNR, CTED; OFM; Revenue); Climate Action Challenge stakeholders; large and small forest landowners; foresters and climate scientists; and general public.

- **Other:**

Implementation Mechanisms:

The design for this mitigation option includes the development of greenhouse gas accounting protocols to quantify and verify real, additional and durable emission reductions that provide emissions reductions exceeding business as usual forest management. The accounting protocols used to quantify emissions reductions should 1) quantify annual increases and decreases in forest carbon stocks above the baseline (live and dead carbon pools), 2) secure/account for the protection (i.e. "permanence") of overall carbon stocks and 3) quantify and verify removals/reductions of CO2 based on stock change accounting.

Any or a combination of the following (or other identified) forest management practices could be implemented to increase and maintain overall forest carbon stocks in Washington forests:

- Increased lengths of harvest rotation.
- Harvest limitations.
- Restocking of under-stocked areas/Reforestation of non-forested areas that were historically in forest cover, both utilizing native tree species.
- Appropriate thinning of over-stocked areas.
- Avoidance of conversion to non-forest uses.
- Widening of forested riparian corridor buffers.

Programs and incentives in support of these methods of practice could include:

- Participation in the development of regional and national carbon markets that allow participation by large and smaller forest landowners.
- Increased use of conservation easements to maintain working forests managed for enhanced carbon sequestration and environmental values.
- New tax incentives that encourage forestry and management for greater forest carbon stocks and that avoid conversion.
- Other identified forest landowner incentives that protect and preserve our forests and address the reality of increased ownership fragmentation.
- Changes to development project environmental review requirements (e.g. SEPA) to require analysis and mitigation of climate impacts, including those related to possible depletion of forest carbon stocks.
- Development fees that fund on-site and/or off-site mitigation for identified climate impacts of projects.
- New "Green Building" (e.g. LEED) standards that require use of wood products from managed and sustainable forestland sources that store additional carbon.

Additional analysis is needed to determine which combination of these or other programs and incentives would yield the most cost effective and environmentally sound absolute increases to levels of sequestered carbon in Washington forests.

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

F-4. Enhanced Carbon Sequestration in Harvested Wood Products

Mitigation Option Description

This policy is focused on recognizing and improving the climate benefits of managing forests for wood production. Washington State is uniquely positioned to take advantage of the climate benefits of durable wood products, because the native Douglas-fir forests have high productivity rates and extremely desirable structural characteristics for long-lived wood products. Washington State can provide abundant sources of raw materials and has the infrastructure to manufacture these materials into products.

Mitigation Option Design

- **Goals:** To increase the production of durable wood products from Washington forests by 10% by 2050.
- **Timing:** See goals above. The demand for wood products should increase as the climate benefits of using a product with low embodied energy (in many cases a negative carbon footprint) is realized. See F-4 for more information on the expanded use of wood products for building materials.
- **Coverage of parties:**
- **Other:** The long-term carbon storage contribution of Washington State's wood product production is roughly 11.8 million metric tons CO2e/yr[1], which offsets more than 10 percent of Washington's greenhouse gas emissions.
- These goals assume no additional barriers to efficient management of timberlands and production capacity.

Implementation Mechanisms:

Full carbon accounting: all forestry assessments should include wood product carbon storage as a mandatory pool along with above and below-ground biomass etc… Without recognizing wood product storage as a carbon pool, an incomplete picture of the carbon cycle is given.

- Incentives for increasing productivity on Washington timberlands. These may include to increasing technical assistance for non-industrial private landowners, including funding for writing forest management plans (perhaps through the American Tree Farm System or Washington State's Forest Stewardship Program).
- Encouraging smart application of silvicultural treatments such as fertilization, thinning, and pruning.

[1] From draft of state inventory

- Incentives for increasing recovery rates at mills. This would result in more carbon storage in long-term wood products with the same input of raw material. The wood products that result from improvements in recovery rates should be considered additional carbon storage.

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

F-5. Expanded Use of Wood Products for Building Materials

Mitigation Option Description

This policy seeks to enhance the use of long-lived wood products as a strategy for reducing GHG emissions. Wood products not only store significant amounts of carbon but they are also less energy intensive to manufacture than substitute materials. The climate benefits of using wood products as opposed to substitute materials have been documented in numerous life cycle assessments.

Enhancement of wood product use can be achieved through transparent inclusion of carbon footprint/embodied energy information in green building standards and in consumer literature. Any increase must be done with consideration of practical use of the material and of material costs.

Mitigation Option Design

- **Goals:** To expand the use of wood products for building materials, where appropriate, by 10% over current levels
- **Timing:** Increase usage by 5% by 2010 and 10% by 2020, above current trends
- **Coverage of parties:** Builders, building material suppliers, wood product industries, recycled building material sellers, home improvement stores and consumers. All state agencies should lead through example.
- **Other:** Wood products not only serve as long-term carbon storage but also require much less energy to manufacture than substitute materials such as concrete or steel. This difference in energy use is so significant that one study found a substitution for steel and concrete framing representing 6 to 8 percent of the total house weight resulted in an increase in greenhouse gas emissions of 26 to 31 percent respectively[2]. Other studies have echoed these same results. Eriksson's (2003) compilation of building life cycle assessments (LCAs) concluded that using wood-framed housing in the 1.7 million housing starts in Europe[3] would save 35-50 MMtCO2e, which would be enough to contribute 11-16% of the emissions reduction needed for Europe to meet the Kyoto requirement. Buchanon and Levine (1999) report that a 17% increase in wood usage in the New Zealand building industry could result in a reduction of 484,000 MMtCO2e.

---

[2] Taken from the CORRIM study, Perez-Garcia, Bruce Lippke, David Briggs, James Wilson, James Bowyer and Jaime Meil. 2005. The Environmental performance of renewable building materials in the context of residential construction. *Wood and Fiber Science* 37, CORRIM Special Issue: 3-17.

[3] Currently only 5% of new construction in Europe uses wood framing

This reduction is equivalent to a 20% reduction in carbon emissions from the New Zealand building industry and roughly a 1.8% of New Zealand's total GHG emissions. Miner et al (2006) report that, according to the CORRIM work, if 1.5 million housing starts in the U.S. used wood framed houses rather than non-wood building systems, 9.6 MMtCO2e per year would be kept out of the atmosphere. This savings is equivalent to keeping roughly two million cars of the road for one year.

Implementation Mechanisms:

Including embodied energy/carbon footprint/life cycle assessment information for building materials in green building standards. This can be achieved through the deployment of material election LCI tools, such as the GBI's LCA tool for material assemblies (developed primarily for use in GBI's Green Globe environmental assessment and rating system for commercial buildings) or BREEAM (used in Ecohomes, the predominant UK green building standard)

- Include carbon footprint information/literature on materials in building supply and home improvement stores
- State adopted policies: the state should adopt policies that require wood products in the construction and maintenance of all state buildings when those products are feasible and relatively close in price (within 5%) to the alternative. Education/Outreach: Develop information and education programs to promote product substitution (using wood products whenever and wherever feasible) and the benefits gained through carbon sequestration and avoided emissions.
- Promotion of product life-time? (recycled stores, preservatives) New product development?

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

F-6. Expanded Use of Biomass Feedstocks for Electricity, Heat and Steam Production

Mitigation Option Description

F-5 seeks to encourage forest product manufacturing facilities to use biomass to produce power for their own use, with surplus fed back to the energy grid. This option could be an outlet for the biomass produced as a result of policies implemented pursuant to option F-1.

Mitigation Option Design

- **Goals:** Achieve biomass generation capacity at 50% of Washington State forest products facilities by 2020; achieve biomass generation capacity at 100% of Washington State forest products facilities by 2035.
- **Timing:**
- 2010: Complete assessment of biomass generation capability for Washington State forest products facilities.
- 2020: 50% of Washington State forest products facilities will have some biomass generation capability. Pulp mills will replace aged recovery furnaces with high pressure systems or combined cycle gasification units.
- 2035: All Washington State forest products facilities will have state of the art biomass generation capability. In particular all pulp mills have either high pressure recovery furnaces or combined cycle gasification units.
- **Coverage of parties:**
- **Other:**

About 70% of Washington State electricity comes from non-carbon emitting sources, including hydroelectric and nuclear. Electricity generation, therefore, should be considered as a lower pollution avoidance priority for forest biomass utilization than solid wood products, which can sequester carbon for many decades, or for transportation fuels, which must be made from biomass to be carbon neutral and displace reliance on fossil fuels. There are opportunities, however, where local circumstances may make generation of electricity from biomass a logical energy alternative and these should be developed to the maximum extent possible. In particular, many forest product manufacturing facilities, such as pulp and paper mills and lumber mills, have co-generation capability to produce steam for industrial processes and electricity for their own use with surpluses supplied to the grid. Boilers should be state of the art such that the maximum energy is recovered from each ton of biomass. Facilities that currently do not incorporate cogeneration capabilities represent low cost opportunities for new renewable energy investment.

- New conversion technology that is optimized for Washington State biomass may need to be developed. The timing for this type of development work would be longer than the horizon presented above.

Implementation Mechanisms:

Goal 1 can be achieved with grants to Universities to perform the assessment. Goals 2 and 3 would require industry to commit capital for construction of modern co-generation facilities. Incentives that may be required for this construction include:

- Grants for construction
- Tax breaks for biorefinery operations
- Subsidy of biomass cost in recognition of environmental benefit of using biomass for fuel.
- Subsidy ($0.10/kWhr) for bio-based electricity *including pulp mill black liquor*.

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:**
  - This option seeks to achieve biomass generation capacity at 100% of Washington State forest product facilities by 2035.
  - The GHG reductions of this policy option will be based on the avoided emissions of displaced energy production (heat and/or electricity)Displaced energy type: electricity, heat, less efficient biomass energy source
  - Improved biomass energy type: BGCC (black liquor), high pressure turbines, waste heat utilization for municipal buildings (fuels for schools)
  - Analysis of reduction will be from 2008 – 2020
- **Key Assumptions:**
  - Current and likely future biomass utilization at forest product facilities (need input/data sources from TWG)
  - Emission factors for heat and electricity production w/out biofuel (e.g., 116.7 lbsCO2e/MMBtu in NM, assumes natural gas is used)
  - Emission factor for heat and electricity production w/ biofuel (e.g., 14.96 lbsCO2e/MMBtu for biomass in NM)
  - Cost/characteristics/choice of improved biomass energy technologies

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

F-7. Improved Commercialization of Advanced Lignocellulosic Processes

Mitigation Option Description

F-6 seeks to develop and implement technology that can convert wood biomass to biofuels. These fuels could then be used for transportation or other uses, offsetting fossil fuel emissions that would otherwise take place. This option intersects with F-1, which seeks to reduce the buildup of fuels which can increase the risk of wildfire. This policy option will aim to promote sustainable forest management strategies which provide wood biomass for biofuels production while maintaining forest productivity, carbon storage, and integrity of forest ecosystems..

Mitigation Option Design

- **Goals:** Produce 1.36 billion gallons (50% of current Washington State fuel demand) of biofuels from wood by 2050.
- 2012: Commence construction of 1st commercial scale lignocellulose biorefinery to produce 100 million gallons a year of ethanol – utilizing 1.25 million tons of dry biomass per year. This refinery should be operational in 2015.
- 2020: Produce 320 million gallons of ethanol per year, using 4 million tons of dry biomass per year.
- 2035: Produce 640 million gallons of ethanol per year (8 million tons biomass per year)
- 2050: Produce 1.36 billion gallon ethanol per year (roughly half of Washington State current consumption) using 17 million tons of dry biomass per year.
- *Goals for biofuel production may be revised as information regarding biomass supply in Washington State is further refined.*

Road map to first commercial biorefinery.

- Research and analysis to support construction of 1st Washington State biorefinery.
    - Identify and assess lignocelluloses conversion technologies on Washington State biomass.
    - Perform techno- economic analysis of most promising candidates to assess technical economic feasibility
    - Assess broad environmental impact by means of life-cycle analysis or other encompassing mechanism

  Start 2008 – Complete 2011
- Construct demonstration scale biorefinery facility with best technology – 100 tons/day biomass (~ 3 million gallons fuel year)

Start 2010 – Complete 2012

- Construction commercial scale biorefinery (3500 tons/day biomass) 100 million gallons of fuel/ year

  Start 2012 – Complete 2015

- **Timing**: See goals above
- **Coverage of parties:**
- **Other:** Conservatively there are 17 million tons of biomass that could be used for manufacture of fuels and energy available annually in Washington. About eight million tons of that is forestry biomass. Much more forestry biomass is available if you consider use of forest slash currently left in the woods, and all the biomass that should be removed for fire treatment. The US Forest Service estimates that a total of 240 million tons of wood biomass needs to be removed from eastside forests to reduce surplus fuel loads and forest fire hazard. Effective use of this biomass would significantly reduce Washington State green house gas emissions. Use of all eight million tons of annual available forest biomass to produce 640 million gallons of transportation fuels would reduce Washington's greenhouse gas emissions by about 4 MMTCo2e annually. In contrast, if these 640 million gallons were produced from corn it would only reduce green house gas emissions by about 0.5 MMT CO2e (also annually?). Further, reducing incidence and magnitude of forest fires by removing forest thinning and slash for fuel production could avoid CO_2 releases from smoke equivalent to an additional 2 MMTCO2e per year.
- New conversion technology that is optimized for Washington State biomass may need to be developed. The timing for this type of development work would be longer than the horizon presented above.

Implementation Mechanisms:

Analysis work required prior to building the 1st biorefinery can be accomplished with grants to Universities and engineering firms. An industrial partner would need to take the lead on building the demonstration and commercial scale biorefinery. Universities and engineering firms engaged in the assessment would be part of the consortium to build and operate the demonstration unit.

Incentives for construction of biorefineries include the following:

- Support for research and development of biorefinery technologies
- Grants for construction
- Tax break for biorefinery operations
- Subsidy of biomass cost in recognition of environmental benefit of using biomass for fuel.
- Subsidy of transportation fuel produced from biomass. Federal government is considering $1.06/gallon subsidy of ethanol produced from lignincellulosics.

Related Policies/Programs in Place

Policies:
http://www.sccd.org/policy/WashingtonBiofuelsIncentives.shtml

http://www.sccd.org/policy/RenewableFuelRequirement.shtml

Types(s) of GHG Reductions

TBD

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

- **Data Sources:**
  - Production Levels: need TWG input
  - Biomass Supply:
    - DOE-WSU. 2005. Biomass Inventory and Bioenergy Assessment: An Evaluation of Organic material Resources for Bioenergy Production in Washington State. Publication No. 05-07-047 http://www.ecy.wa.gov/pubs/0507047.pdf
    - Rummer, B., J. Prestemon, M. D., P. Miles, J. Vissage, R. McRoberts, G. Liknes, W. D. Shepperd, D. Ferguson, W. Elliot, S. Miller, S. Reutebuch, J. Barbour, J. Fried, B. Stokes, E. Bilek, and K. Skog. 2003. A Strategic Assessment of Forest Biomass and Fuel Reduction Treatments in Western States. United States Department of Agriculture Forest Service Research and Development. http://www.fs.fed.us/rm/pubs/rmrs_gtr149.pdf
    - WGA-CDEAC. 2006b. Biomass Task Force Report: Supply Addendum. Western Governors' Association's Clean and Diversified Energy Advisory Committee. http://www.westgov.org/wga/initiatives/cdeac/Biomass-full.pdf
  - Net GHG emissions (Farrell et al. 2006):
    Reference Only: Additional data sources will be evaluated.

Fuel Type	Net GHG emissions (g CO2e / MJ)
Gasoline	94
Ethanol Today	77
Ethanol (CO2 Intensive)	91
Cellulosic Ethanol	11

Ethanol Today: *Based on U.S. corn ethanol industry and requires the fewest assumptions*
Ethanol (CO2 Intensive): *Transport of corn from Nebraska to ethanol plant in North Dakota*
Cellulosic Ethanol: *Production from switchgrass based on assumptions of future technological and economic feasibility.*

  - Costs: need TWG input
  - Cost savings: need TWG input

-

- **Quantification Methods:**
  - This policy option seeks to produce 1.36 billion gallons of biofuels from wood by 2050.
  - The GHG reductions of this policy option will be based on the relative full fuel cycle emissions estimates of biofuels (lignocellulosic ethanol, methanol ?) compared with displaced fuels (i.e. gasoline, diesel, starch-based ethanol). Relative emissions will be based on available literature estimates (e.g. Farrell et al. 2006)

- Analysis of reduction will be from 2008 – 2020

- **Key Assumptions:**
  - Production levels:
    - As indicated in goals statement (50% of projected WA fuel demand by 2050)
  - Biomass required:
    - As indicated in goals statement (17 million tons of dry biomass per year by 2050)
  - Displaced fuels:
    - As to be clarified in goals statement (X% gasoline; X% diesel, X% other biomass fuel type)
  - Interaction with other WA state biofuels policies:
    - WA State Fuel Quality Standards Act
    - TLU-11

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

F-8. Urban and Community Forests

Mitigation Option Description

Establish and maintain a net increase of urban and community forest in Washington. Use incentives, emerging carbon markets, education, outreach and appropriate regulatory mechanisms to enable strategic planting and maintenance of trees where we live to

- ☐ Conserve energy
- ☐ Reduce greenhouse gas emissions
- ☐ Offset greenhouse gas emissions and to
- ☐ Attract density to urban areas (reduce sprawl)

Trees of the ***urban forest modify climate and conserve building-energy*** *use in three principle ways:*

- *Shading—reduces the amount of radiant energy absorbed and stored by built surfaces.*
- *Transpiration—converts moisture to water vapor and thus cools by using solar energy that would otherwise result in heating of the air.*
- *Wind speed reduction—reduces the infiltration of outside air into interior spaces and conductive heat loss where thermal conductivity is relatively high (e.g. glass windows)* (McPherson et. al. 2002)[4].

Urban Forests can reduce atmospheric CO_2 in two ways:

- *Trees directly sequester Co2 as woody and foliar biomass while they grow, and*
- *Trees near buildings can reduce the demand for heating and air conditioning, thereby reducing emissions associated with electric power production.* (McPherson et. al. 2002).

Treed Communities can concentrate consumers and residents:

[4] Mcpherson, E.G.; Maco, S.E.; Simpson, J.R.; Peper, P.J.; Xiao, Q.; VanDerZanden, A.M.; Bell, N.; 2002. **Western Washington and Oregon Community Tree Guide: Benefits, Costs and Strategic Planting**. Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station. http://www.fs.fed.us/psw/programs/cufr/products/5/CUFR_164_Western_WA_OR_Tree_Guide.pdf

- *Consumers shop longer, more frequently and are willing to pay more for goods/services in well-landscaped business districts*
- *Well maintained trees maintain the "curb-appeal" of properties*
- *Treed cities are desirable communities with stronger communities, less crime, cleaner air, less noise, more wildlife and improved aesthetics.* (McPherson et. al. 2002).

Other benefits of urban and community forests (i.e. improving air quality, reducing storm water runoff, improving aesthetics) make it a highly desirable community investment for reasons beyond the benefits to climate change.

Mitigation Option Design

Goals: ***By the year 2020, enable Washington's local governments, utilities and large urban landowners to protect, plant and maintain an additional 3 million trees, and increase the quality of urban forests to***

- conserve energy
- reduce greenhouse gas emissions
- offset green house gases (and tapping emerging carbon markets)
- benefit healthy neighborhoods and business districts, and to
- reduce sprawl

By 2035, protect, plant and maintain 6 million trees, and

By 2050, protect, plant and maintain 12 million trees.

And…Achieve or exceed prescribed municipal canopy goals for all cities by 2050

West of the Cascades

For metropolitan areas east of the Mississippi and in the Pacific Northwest:

Average tree cover counting all zones	40%
Suburban residential zones	50%
Urban residential zones	25%
Central business districts	15%

East of the Cascades

For metropolitan areas in the Southwest and dry West:

Average tree cover counting all zones	25%
Suburban residential zones	35%
Urban residential zones	18%
Central business districts	9%

http://www.americanforests.org/resources/urbanforests/treedeficit.php

Why Set Tree Canopy Goals?
Tree cover in urban areas east of the Mississippi has declined by about 30% over the last 20 years while the foot print of the urban areas has increased by 20%. With this decline in tree cover, significant air and water management costs have increased.

http://www.americanforests.org/resources/urbanforests/treedeficit.php
Tree cover is directly related to environmental quality. Maintaining a robust enough tree cover to function as green infrastructure reduces the need and expense of building infrastructure to manage air and water resources. Local agencies can use CITYgreen software to calculate the environmental and economic values of the ecosystem services that trees provide. American Forests' intent is to help communities calculate the value of their trees so that city leaders can make better decisions about integrating "green" into their urban infrastructure.

- **Timing:** Dependent on funding available and timing of The Carbon Registry timing for development / adoption of urban forest greenhouse gas reporting protocols.
- **Coverage of parties:** Affected parties, end users--Municipalities and local governments, utilities, large urban/suburban landowners, private business and homeowners.

  Implementing parties--DNR, CTED, DOT, local governments.
- **Other:**
  - **Definitions: (place holder)**
    - *Urban Forest:*
    - *Community Forest:*
    - *Exurban Forest:*
  - **Community & Urban Forest fragmentation/conversion rates: (place holder)**

Implementation Mechanisms:

- **Energy Conservation / Emissions Reduction**
  - Incentivize / require local ordinances that plant the right trees in the right place to conserve energy (heating and cooling) in new homes and businesses built after 20XX
  - Incentivize & educate home and business owners to position the right trees in the right place to conserve energy (heating and cooling)
  - Incentivize / require local municipalities to develop and implement forest management plans that include goals and strategies to increasing number of trees to reduce “heat island” effect and reduce heating/cooling costs around public buildings, businesses and homes.
  - Require / encourage urban forest byproducts to manage, minimize or slow rate of CO_2 volatility (feasibility unlikely—may not pencil out)
    - No burning
    - Solid fuels / biofuels?

- Recycled (mulch?)

- **Carbon Sequestration (Offsets)**

  - Establish statewide inventory and baseline of community and urban forests in WA.
  - Require state to begin using emerging Urban Forest Greenhouse Gas reporting protocols for sectors or projects voluntarily "reporting" to DNR.
  - Establish state goal for increasing number of additional trees in urban and suburban settings – xx million trees by year 20XX.
  - Establish sub-goals for maintenance of existing trees/forests, additionality of protecting trees otherwise slated for removal and preparation of planting sites—esp. removal of invasive species.
  - Enable municipalities, utilities, and large urban landowners to help meet that goal through state "seed grants."
  - Require "reporting" to DNR for eligibility to "seed grants".
  - Position Washington's additional urban trees for carbon offset markets.
  - Establish disincentives ($ civil penalties) for violations of local ordinances or permits requiring tree retention.
  - Consider impact fees and or 4:1 tree mitigation requirements for trees lost in cities and communities from development or other permanent conversion of forested land.
  - Fees above local component go into "seed grant" account.

- **Averting Sprawl – Livable Cities**

  - Transportation Mitigation
    - Establish / require tree-lined streets protocols based on road traffic capacity
    - Establish greenways and urban forest corridors
    - Require "mitigation" for deforestation and traffic impacts

      Implement within urban growth boundaries. Developers to replace trees either within the UGB or by establishing trees outside the UGB and putting them under a conservation easement.

    - Establish Highway Greenway stem/easement requirements for WSDOT and other road builders.
    - Transfer of Development Rights
      - Prioritize Municipalities utilizing Transfer of Development Rights from working exurban forestland to secure seed grants

Related Policies/Programs in Place

RCW 76.15 – enabling legislation for the state's Community and Urban Forestry Program and Community Forest Council. http://apps.leg.wa.gov/RCW/default.aspx?cite=76.15

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