NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Direct Land Use GHG, Reversion

Reference Flow: 1 m^2 of land transformation

Brief Description: Direct GHG emissions from land transformation with reversion.

Section I: Meta Data

Geographical Coverage: United States **Region:** National

Year Data Best Represents: 2009

Process Type: Basic Process (BP)

Process Scope: Gate-to-Gate Process (GG)

Allocation Applied: No

Completeness: All Relevant Flows Captured

Flows Aggregated in Data Set:

☑ Process ☐ Energy Use ☐ Energy P&D ☐ Material P&D

Relevant Output Flows Included in Data Set:

Releases to Air:	☑ Greenhouse Gases	☐ Criteria Air	☐ Other
Releases to Water:	☐ Inorganic	☐ Organic Emissions	☐ Other
Water Usage:	☐ Water Consumption	☐ Water Demand (throughput)	
Releases to Soil:	☐ Inorganic Releases	☐ Organic Releases	☐ Other

Adjustable Process Parameters:

Grassland	*[dimensionless] Fraction of original land area that was grassland*
Forest	*[dimensionless] Fraction of original land area that was forest*
Agriculture	*[dimensionless] Fraction of original land area that was agriculture*
EF_GHG_grass	*[kg/m^2] Direct CO_2 emission factor per unit of grassland transformed*

EF_GHG_forest	*[kg/m^2] Direct CO_2 emission factor per unit of forest transformed*
EF_GHG_ag	*[kg/m^2] Direct CO_2 emission factor per unit of agricultural land transformed*

Tracked Input Flows:

Indirect land transformation	*[Technosphere] Transformation of land use, with no reversion to original land type*

Tracked Output Flows:

Land transformation	*Reference flow*
Carbon dioxide	*Direct GHG emissions from land transformation*

Section II: Process Description

Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_Stage1-5_C_Land_Use_GHG_Reversion_2012.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

This unit process provides a summary of relevant input and output flows for the direct GHG emissions from land transformation with reversion to the original land type. The reference flow of this unit process is: 1 m^2 of land transformation.

Boundary and Description

Land use effects can be roughly divided into direct and indirect. Direct land use change is determined by tracking the change from an existing land use type (native vegetation or agricultural lands) to a new land use that supports production (i.e., the production required for the supply chain of an LCA). Indirect land use effects are changes in land use that occur as a result of the direct land use effects. For instance, if the direct effect is the conversion of agricultural land to land used for energy production, an indirect effect might be the conversion to new farmland of native vegetation, but at a remote

location, in order to meet ongoing food supply/demand. This unit process accounts only for the GHG emissions from direct land use change with reversion to the original land type. Emissions from indirect land use and direct land use with no reversion are accounted for in other unit processes.

This analysis uses data that accounts for changes in GHG emissions when alternating among forest, grassland, and agricultural land types. The data are based on research conducted by Winrock International (Harris et al., 2009) in support of EPA's RFS2 final rule.

The values for direct land use GHG emissions account for changes in aboveground biomass stocks, lost forest carbon sequestration, and soil carbon flux. The Winrock data account for changes in GHG emissions over an 80 year period. The time frames within this 80 year period include the impulse of emissions in Year 0, steady-state emissions during Years 1 through 19, and steady-state emissions in Years 20-80. NETL's LCA analyses of energy systems are usually on a 30-year time frame, so this analysis calculates a 30-year direct land use GHG emission factor by assembling the Winrock data over a 30-year time frame. The GHG emissions for the reversion cases model transformation at Year 0, 2 years of emissions from conversion, Year 0 uptake emissions, 19 years of Year 1-19 uptake emissions, and 8 years of Year 20-80 uptake emissions.

The Winrock data include a set of factors for non-reversion and reversion cases. This unit process applies the factors for reversion. One set of factors is applied if the land is permanently converted to a new land use type. For example, the construction of a pipeline or transmission line will convert land to a new use, but the pipeline or transmission line right-of-ways return to their original land use type within a couple years.

This unit process also includes factors for the land use profile at a state level. This land use profile accounts for the percent shares of forest, grassland, and crops and allows determination of the previous land use type (Lubowski et al., 2006). These parameters can be adjusted in the unit process if there is a better understanding of the previous land use type of the system of interest. For example, if it is unlikely that a facility will be built on agricultural land, the percent share of crop land can be set to zero, and the other land types (forest and grassland) can be rescaled accordingly.

This unit process references the amount of land use area for indirect land use change based on the amount of agricultural (crop) land that undergoes direct land use change. For every unit of agricultural land that undergoes direct change, the same area of indirect land change occurs elsewhere. The emissions from indirect land change are accounted for in another unit process.

Figure 1: Unit Process Scope and Boundary

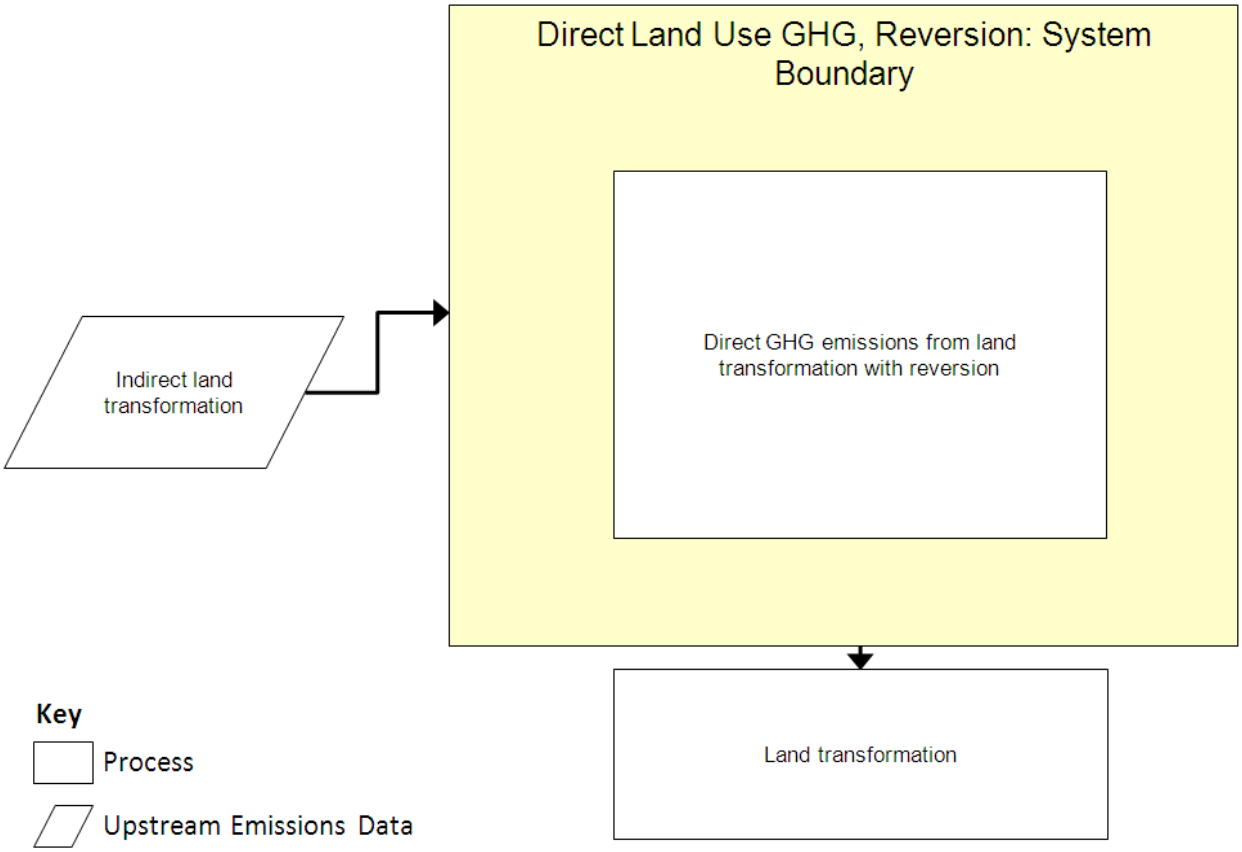

Table 1: Direct GHG Emission Factors with Land Reversion

Land Type	State	Direct GHG Emission Factor	
		tonne CO_2/hectare	kg CO2/m^2
Forest	Colorado	-1.4	-1.41E-01
	New Mexico	-47.3	-4.73E+00
	Oklahoma	-42.6	-4.26E+00
	Texas	-51.8	-5.18E+00
	Wyoming	46.7	4.67E+00
Grassland	Colorado	-22.4	-2.24E+00
	New Mexico	-16.9	-1.69E+00
	Oklahoma	-30.0	-3.00E+00
	Texas	-25.3	-2.53E+00
	Wyoming	-21.1	-2.11E+00

Table 2: Unit Process Input and Output Flows

Flow Name	Value	Units (Per Reference Flow)
Inputs		
Indirect land transformation	0.27	m^2
Outputs		
Land transformation	1.00	m^2
Carbon dioxide	-2.06E+00	kg

* **Bold face** clarifies that the value shown *does not* include upstream environmental flows.

Embedded Unit Processes

None.

References

Harris et al. 2009 — Harris et al., 2009. Land use change and emission factors: Updates since proposed RFS rule. Environmental Protection Agency. Washington, D.C.

Lubowski et al., 2006. — Major Uses of Land in The United States, 2002. United States Department of Agriculture. Accessed on December 5, 2012 at http://www.ers.usda.gov/media/250091/eib14_1_.pdf

Section III: Document Control Information

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