

**Lifecycle Emissions of POET's
LIBERTY Cellulosic Ethanol Plant**

1.0 Executive Summary

AIR, Inc. conducted a life cycle analysis for POET's cellulosic ethanol plant, Project LIBERTY, which is being constructed in Emmetsburg, Iowa. It will produce approximately 25 million gallons of ethanol annually using as feedstock the cobs and upper 25% of the stover. A co-product from this biochemical ethanol refinery is a biogas that will be used to replace natural gas in POET's collocated corn-based refinery, which has an annual output of 50 million gallons.

We estimated emissions from collection of the stover, transport of the stover to the production facility, production of ethanol from the stover, and transport of ethanol to blending facilities. It is important to note that stover removal rates from fields around Project LIBERTY will not be more than 25% of total stover on the fields, so that additional fertilizer will not be necessary for the next corn crop. Consequently, we are estimating no increase in agriculture emissions due to the stover removal for the Project LIBERTY facility.

The emissions for the different processes, expressed as carbon dioxide equivalents (CO₂e) are summarized in Table ES-1 below.

Table ES-1. Summary of CO₂e emissions associated with LIBERTY	
Process/Activity	CO ₂ Emission Rate (gCO ₂ eq/MJ)
Stover Harvesting	1.419
Stover Transport to LIBERTY	0.526
Storage	0.236
Electricity	37.041
Chemicals	0.072
Waste Disposal	0.028
Transportation & Distribution	2.535
Biogas Production	- 49.826
Total	-7.969

Because the biogas is replacing natural gas, the Project LIBERTY plant can take credit for the natural gas emissions it displaces and this results in a large negative contribution to the facilities greenhouse gas (GHG) emissions. In fact the net emissions are negative at -8.0 gCO₂e/MJ of ethanol produced.

Table ES-2 shows a comparison of the Project LIBERTY process with EPA's estimate of emission reductions in the RFS2 for corn stover using a biochemical process. Since stover harvesting is part of EPA's Net Domestic Agriculture" category, we have subtracted the 1.4 g CO₂ eq/MJ from EPA's estimate of 10 g CO₂eq/MJ to obtain 8.6 g/MJ for Project LIBERTY. Net international agriculture, domestic land use change, and international land use change, are assumed to be the same as EPA's estimates, which were developed from FASOM and FAPRI modeling. Fuel production for Project LIBERTY is the sum of storage, electricity, chemicals, waste disposal, and biogas production from Table ES-1. Our estimate of Project LIBERTY's fuel

and feedstock transport is slightly higher than EPA's, and we are assuming the same tailpipe emissions. Project LIBERTY thus achieves a 111% reduction in emissions from a gasoline baseline of 92.9 g CO₂eq/MJ, as determined by EPA. As a result, Project LIBERTY's ethanol product easily qualifies as a cellulosic fuel, which must achieve a minimum reduction of 60%.

The reduction is somewhat less than EPA's because EPA assumes the lignin is combusted to produce renewable electricity, which results in a somewhat higher credit than utilizing the lignin to produce biogas.

Process/Activity	Project LIBERTY	EPA-RFS2 Corn Stover Bio-Chemical
Net Domestic Agriculture	8.6	10
Net International Agriculture (EPA RFS2)	0	0
Domestic Land Use Change (EPA RFS2)	-10	-10
International Land Use Change	0	0
Fuel Production	-12.4	-31.3
Fuel and Feedstock Transport	3.1	1.9
Tailpipe	1	1
Total Emissions	-9.7	-28.4
% Reduction of Gasoline	111%	130%

In addition to the extremely low estimated GHG emissions from the Project LIBERTY operation, it is important to note that the use of biogas from the Project LIBERTY facility will also reduce GHG emissions from the collocated corn-ethanol facility, which is currently utilizing natural gas, mainly to dry distillers grains. These "downstream" GHG emission benefits from the Project LIBERTY facility have not been taken into account in this analysis, but will be taken into account in a future analysis of the collocated corn-ethanol facility.