NETL Life Cycle Inventory Data
Process Documentation File

Process Name: Ethanol Dry Milling Process, Energy Conversion

Reference Flow: 1 kg of Ethanol (E95)

Brief Description: This process includes all inputs and relevant environmental flows for the energy conversion for 1 kg of ethanol, based on a dry milling process using corn grain.

Section I: Meta Data

Geographical Coverage: US **Region:** Midwest

Year Data Best Represents: 2009

Process Type: Energy Conversion (EC)

Process Scope: Cradle-to-Gate Process (CG)

Allocation Applied: Yes

Completeness: Individual 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 Pollutants	☒ Other
Releases to Water:	☒ Inorganic Emissions	☐ Organic Emissions	☒ Other
Water Usage:	☐ Water Consumption	☒ Water Demand (throughput)	
Releases to Soil:	☒ Inorganic Releases	☐ Organic Releases	☒ Other

Adjustable Process Parameters:

ETHANOL_PROD	*Ethanol produced by the energy conversion facility, total mass per 30-year study period*
S3_DISPL_FEED	*Mass of corn displaced by dried distillers grains with solubles (DDGS)*

Tracked Input Flows:

Corn Grain Biomass	*Mass of corn fed into the energy conversion facility, in support of ethanol production*

Tracked Output Flows:

Ethanol (E95) [Valuable substance]	*Ethanol fuel (E95) produced by the energy conversion facility and ready for transport*

Section II: Process Description

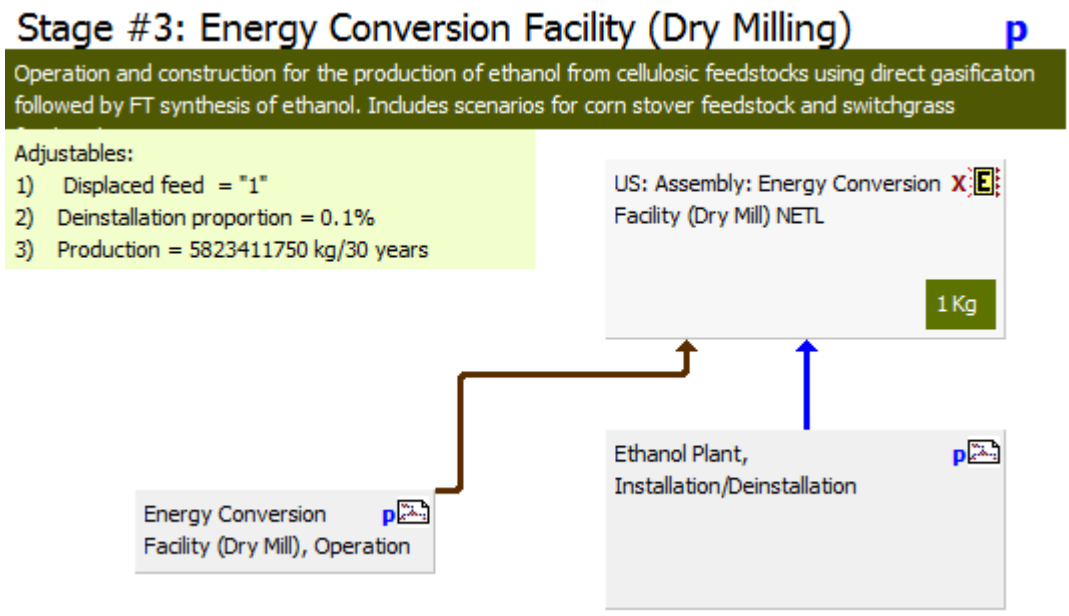
Associated Documentation

This unit process is composed of this document and the data sheet (DS) *DS_ECF_Ethanol_DryMill _2011.01.xls*, which provides additional details regarding relevant calculations, data quality, and references.

Goal and Scope

The scope of this unit process covers the energy conversion facility (ECF) for the production of ethanol (E95) via dry mill process, as shown in **Figure 1**. At the downstream boundary of this unit process, one kilogram finished ethanol (E95) is delivered to the upstream boundary of finished fuels transport (LC Stage #4).

Figure 1: Plan for Ethanol Dry Milling Energy Conversion Facility



Boundary and Description

LC Stage #3 (ECF) includes the conversion of raw corn grain to fuel-grade ethanol (E95), via a dry milling process. Consistent with a dry milling process, operation of the facility is presumed to result in the production of dry distillers grains with solubles (DDGS). DDGS are assumed to displace corn feed, at a ratio indicated by the adjustable parameter, S3_DISPL_FEED, as noted previously (default value of 1.0). Finished ethanol

from the ECF process is delivered to the upstream boundary of LC Stage #4, finished fuels transport.

Construction of conventional dry mill ethanol plant is not included in the model for the ECF. Therefore, no construction processes are considered for the ECF.

The profiles and processes included in the ECF are provided in **Table 1**. Those shown in bold face were developed by NETL.

Table 1: Profiles and Processes Included in RMT for Corn Stover

Stage #3: Energy Conversion Facility (Dry Milling)

- Energy Conversion Facility (Dry Mill), Operation
  - US: MROW Grid Power Mix, 2005 (eGRID2007)
    - EU-15: Power from biomass - Energy Quality EDIP
    - GLO: Power from nuclear power plant PE
    - GLO: Power from wind power PE
    - US: MROW Power grid mix, 2005 (eGRID2007) NETL
    - US: Power from hard coal PE
    - US: Power from heavy fuel oil PE
    - US: Power from hydropower PE
    - US: Power from lignite PE
    - US: Power from natural gas PE
  - US: Dry Mill Ethanol Plant Operation NETL <u-so>
  - US: GASOLINE, NATIONAL AVERAGE, 2009 NETL <u-so>
  - US: Natural Gas RMA/RMT, Mix Nominal, 060911 NETL
- Ethanol Plant, Installation/Deinstallation
  - US: DIESEL, NATIONAL AVERAGE, 2009 NETL <u-so>
  - US: Fischer-Tropsch Diesel (FTD) Energy Conversion Facility Commissioning/Decommissioning NETL <u-so>
- US: Assembly: Energy Conversion Facility (Dry Mill) NETL

Parameters and Balances

The parameters for the highest level modeling plans for ECF for corn grain to ethanol production are shown in **Table 2**. These parameters may or may not include the adjustable parameters shown previously, depending on how the model was created. **Table 3** presents the input and output balances for resources and emissions of interest for the ECF plan.

Table 2: Adjustable Parameters for ECF for Corn Grain Ethanol

Plan	Parameter	Value	Comment
LC Stage #3			
Stage #3: Energy Conversion Facility (Dry Milling)	ETHANOL_PROD	5.82E+09	[kg/Study Period] Ethanol production from refinery, per 30-year study period.
Stage #3: Energy Conversion Facility (Dry Milling)	S3_DISPL_FEED	1	[kg] Mass of corn feed displaced by DDGS. Default = 1.

Table 3: Inputs and Output Balances ECF for Ethanol Production via Dry Mill (kg/kg produced)

Process or Category	Gate to Gate (ECF)
Inputs	
Flows	4.937E+00
Resources	4.937E+00
Energy resources	3.672E-01
Non renewable energy resources	3.672E-01
Crude oil (resource)	1.913E-02
Hard coal (resource)	8.670E-02
Lignite (resource)	9.643E-04
Natural gas (resource)	2.604E-01
Uranium (resource)	1.104E-06
Renewable energy resources	1.227E-06
Biomass	1.966E-08
Renewable fuels	1.285E-14
Wood	1.207E-06
Unspecified	0.000E+00
Land use	0.000E+00
Material resources	4.570E+00
Non renewable elements	5.883E-04
Aluminum	9.424E-10
Chromium	9.780E-13
Copper	7.647E-14
Iron	5.850E-04
Lead	6.031E-13
Magnesium	1.155E-15
Mercury	2.876E-13
Nickel	3.621E-15
Phosphorus	1.154E-10

Process or Category	Gate to Gate (ECF)
Sulphur	1.111E-09
Zinc	3.257E-06
Non renewable resources	4.432E-01
Barium sulphate	5.111E-16
Basalt	2.936E-06
Bauxite	1.683E-05
Bentonite	1.043E-04
Calcium carbonate (CaCO3)	6.133E-06
Calcium chloride	5.233E-14
Chalk (Calciumcarbonate)	1.072E-39
Chromium ore (39%)	7.722E-07
Clay	1.319E-05
Colemanite ore	1.554E-07
Copper - Gold - Silver - ore (1,0% Cu; 0,4 g/t Au; 66 g/t Ag)	6.021E-07
Copper - Gold - Silver - ore (1,1% Cu; 0,01 g/t Au; 2,86 g/t Ag)	3.668E-07
Copper - Gold - Silver - ore (1,16% Cu; 0,002 g/t Au; 1,06 g/t Ag)	2.070E-07
Copper - Molybdenum - Gold - Silver - ore (1,13% Cu; 0,02% Mo; 0,01 g/t Au; 2,86 g/t Ag)	5.044E-07
Copper ore (0.14%)	2.914E-05
Copper ore (1.2%)	6.244E-08
Copper ore (4%)	9.609E-17
Copper ore (sulphidic, 1.1%)	4.206E-07
Dolomite	3.157E-05
Feldspar (aluminum silicates)	8.140E-11
Ferro manganese	1.780E-13
Fluorspar (calcium fluoride; fluorite)	1.258E-07
Granite	2.205E-20
Gypsum (natural gypsum)	8.100E-06
Heavy spar (BaSO4)	2.519E-04
Ilmenite (titanium ore)	7.666E-15
Inert rock	4.380E-01
Iron ore (56,86%)	1.101E-04
Iron ore (65%)	2.547E-08
Kaolin ore	2.791E-07
Lead - zinc ore (4.6%-0.6%)	2.101E-05
Limestone (calcium carbonate)	3.524E-03
Magnesit (Magnesium carbonate)	1.653E-10
Magnesium chloride leach (40%)	3.279E-06
Manganese ore	1.490E-07

Process or Category	Gate to Gate (ECF)
Manganese ore (R.O.M.)	8.020E-07
Molybdenite (Mo 0,24%)	3.082E-07
Natural Aggregate	8.723E-04
Nickel ore (1,5%)	4.301E-10
Nickel ore (1.6%)	2.986E-06
Olivine	1.855E-12
Peat	1.781E-07
Phosphate ore	1.062E-10
Phosphorus minerals	1.072E-08
Phosphorus ore (29% P2O5)	6.954E-13
Potassium chloride	1.548E-09
Precious metal ore (R.O.M)	1.278E-08
Quartz sand (silica sand; silicon dioxide)	8.241E-06
Raw pumice	2.709E-08
Rutile (titanium ore)	3.545E-11
sand	2.743E-10
Slate	4.049E-12
Sodium chloride (rock salt)	1.998E-06
Sodium nitrate	6.149E-20
Sodium sulphate	1.808E-11
Soil	1.635E-04
Sulphur (bonded)	4.440E-12
Talc	4.715E-09
Tin ore	4.432E-17
Titanium ore	6.848E-07
Zinc - copper ore (4.07%-2.59%)	5.259E-06
Zinc - lead - copper ore (12%-3%-2%)	2.582E-06
Zinc - lead ore (4.21%-4.96%)	3.281E-17
Zinc ore (4%)	-1.518E-08
Zinc ore (sulphidic, 4%)	6.519E-16
Renewable resources	4.126E+00
Water	2.918E+00
Water	1.039E-01
Water (ground water)	2.260E-01
Water (surface water)	2.319E+00
Water (well water)	8.155E-07
Water (well-produced water)	2.690E-01
Water (with river silt)	2.204E-17

Process or Category	Gate to Gate (ECF)
Air	1.208E+00
Carbon dioxide	1.850E-04
Nitrogen	2.683E-08
Oxygen	2.718E-06
Unspecified	2.704E-07
Unspecified minerals	6.152E-08
Unspecified resources	2.089E-07
Area of Production Land	0.000E+00
Output	
Flows	5.507E+00
Resources	2.127E+00
Energy resources	0.000E+00
Land use	0.000E+00
Material resources	2.127E+00
Renewable resources	2.127E+00
Water	2.127E+00
Water (feed water)	5.735E-05
Water (river water)	1.857E+00
Water (sea water)	3.827E-05
Water (wastewater)	2.695E-01
Nitrogen	0.000E+00
Oxygen	0.000E+00
Ecoinvent	1.117E-11
Long-term emission	1.117E-11
Fresh water	1.117E-11
Dissolved organic carbon, DOC (Ecoinvent)	1.117E-11
Production residues in life cycle	2.098E-05
Hazardous waste for disposal	4.490E-06
Dross (Fines)	2.968E-08
Natrium oxide	5.045E-08
Red mud (dry)	4.383E-06
Soil and sand containing heavy metals	2.121E-08
Toxic chemicals (unspecified)	5.318E-09
Hazardous waste for recovery	3.464E-08
Used oil	7.980E-09
Waste water processing residue	2.666E-08

Process or Category	Gate to Gate (ECF)
Waste for disposal	1.144E-05
Incineration good	2.902E-09
Sludge from water works (6% dry matter-content)	7.067E-10
Waste (solid)	8.797E-06
Waste from steel works	2.644E-06
Waste for recovery	5.012E-06
Aluminum scrap	6.664E-14
Chemicals (unspecified)	1.594E-09
Cooling water	4.941E-06
Cryolite	1.384E-08
Dross	9.959E-09
Gypsum (FDI)	6.519E-15
Plastic (unspecified)	2.995E-09
Production residues (unspecified)	2.209E-11
Rolling tinder	5.574E-21
Slag	4.285E-08
Waste paper	4.400E-13
Wood	1.671E-12
Wooden pallet (EURO)	8.895E-18
Mixed Waste (Hazardous or Radioactive)	0.000E+00
Neutralized residues	1.235E-15
Emissions to air	3.370E+00
Heavy metals to air	2.347E-07
Antimony	2.448E-09
Arsenic (+V)	2.764E-08
Arsenic trioxide	1.416E-14
Cadmium (+II)	1.673E-09
Chromium (+III)	6.269E-12
Chromium (unspecified)	3.030E-09
Cobalt	1.070E-09
Copper (+II)	2.982E-09
Heavy metals to air (unspecified)	6.142E-11
Hydrogen arsenic (arsine)	1.176E-12
Iron	4.251E-10
Lanthanides	6.885E-14
Lead (+II)	1.568E-08
Manganese (+II)	5.916E-09
Mercury (+II)	2.761E-09

Process or Category	Gate to Gate (ECF)
Molybdenum	1.674E-11
Nickel (+II)	3.776E-09
Palladium	1.448E-18
Rhodium	1.398E-18
Selenium	7.109E-08
Silver	2.903E-18
Tellurium	8.359E-13
Thallium	5.975E-12
Tin (+IV)	2.716E-08
Titanium	7.296E-12
Vanadium (+III)	1.616E-08
Zinc (+II)	5.277E-08
Inorganic emissions to air	2.358E+00
Ammonia	1.450E-06
Ammonium	3.759E-12
Ammonium nitrate	2.606E-14
Barium	2.026E-07
Beryllium	3.055E-10
Boron compounds (unspecified)	4.822E-07
Bromine	2.091E-07
Carbon dioxide	9.486E-01
Carbon dioxide (biotic)	8.965E-01
Carbon disulphide	7.880E-13
Carbon monoxide	8.077E-04
Chloride (unspecified)	2.499E-09
Chlorine	4.888E-11
Cyanide (unspecified)	1.067E-10
Fluoride	3.127E-08
Fluorides	8.828E-11
Fluorine	5.691E-12
Helium	3.231E-10
Hydrogen	1.431E-08
Hydrogen bromine (hydrobromic acid)	8.622E-12
Hydrogen chloride	1.617E-06
Hydrogen cyanide (prussic acid)	1.016E-11
Hydrogen fluoride	1.927E-07
Hydrogen iodide	6.420E-15
Hydrogen phosphorous	1.054E-13

Process or Category	Gate to Gate (ECF)
Hydrogen sulphide	2.296E-07
Lead dioxide	1.372E-11
Nitrogen (atmospheric nitrogen)	8.136E-05
Nitrogen dioxide	1.757E-03
Nitrogen monoxide	6.206E-11
Nitrogen oxides	1.480E-03
Nitrous oxide (laughing gas)	1.127E-05
Oxygen	5.221E-05
Scandium	2.103E-14
Steam	5.051E-01
Strontium	1.086E-12
Sulphur dioxide	3.876E-03
Sulphur hexafluoride	1.775E-12
sulphur oxide	4.389E-09
Sulphuric acid	8.815E-11
Tin oxide	2.262E-15
Unspecified Particles	5.035E-07
Zinc oxide	4.523E-15
Zinc sulphate	2.943E-11
Organic emissions to air (group VOC)	6.340E-03
Group NMVOC to air	6.431E-04
Group PAH to air	5.552E-09
Anthracene	3.575E-12
Benzo{a}anthracene	1.799E-12
Benzo{a}pyrene	1.372E-09
Benzo{ghi}perylene	1.605E-12
Benzofluoranthene	3.210E-12
Chrysene	4.419E-12
Dibenz(a)anthracene	1.000E-12
Indeno[1,2,3-cd]pyrene	1.194E-12
Naphthalene	3.755E-10
Phenanthrene	1.180E-10
Polycyclic aromatic hydrocarbons (PAH)	3.670E-09
Halogenated organic emissions to air	2.181E-08
Dichloroethane (ethylene dichloride)	3.128E-16
Dichloromethane (methylene chloride)	1.253E-14
Dioxins (unspec.)	8.154E-15
Halogenated hydrocarbons (unspecified)	1.495E-12

Process or Category	Gate to Gate (ECF)
Polychlorinated biphenyls (PCB unspecified)	2.569E-12
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	1.301E-14
R 11 (trichlorofluoromethane)	8.108E-09
R 114 (dichlorotetrafluoroethane)	8.303E-09
R 116 (hexafluoroethane)	5.400E-11
R 12 (dichlorodifluoromethane)	1.743E-09
R 13 (chlorotrifluoromethane)	1.095E-09
R 22 (chlorodifluoromethane)	1.905E-09
Tetrafluoromethane	5.454E-10
Vinyl chloride (VCM; chloroethene)	4.958E-11
Acetaldehyde (Ethanal)	4.413E-09
Acetic acid	2.195E-08
Acetone (dimethylcetone)	4.311E-09
Acrolein	2.523E-11
Aldehyde (unspecified)	1.069E-09
Alkane (unspecified)	1.147E-06
Alkene (unspecified)	1.132E-06
Aromatic hydrocarbons (unspecified)	1.562E-09
Benzene	2.412E-08
Butadiene	3.710E-12
Butane	1.871E-06
Butane (n-butane)	1.522E-07
Caprolactam	8.532E-13
Cyclohexane (hexahydro benzene)	1.348E-11
Diethylamine	9.397E-17
Ethane	5.476E-06
Ethanol	1.303E-08
Ethene (ethylene)	3.830E-10
Ethyl benzene	1.132E-06
Fluoranthene	1.164E-11
Fluorene	3.695E-11
Formaldehyde (methanal)	3.655E-07
Heptane (isomers)	5.676E-08
Hexamethylene diamine (HMDA)	2.182E-13
Hexane (isomers)	8.695E-08
Mercaptan (unspecified)	5.524E-10
Methanethiol	1.280E-08
Methanol	7.766E-09

Process or Category	Gate to Gate (ECF)
NMVOC (unspecified)	6.157E-04
Octane	3.123E-08
Pentane (n-pentane)	1.449E-06
Phenol (hydroxy benzene)	2.755E-13
Propane	8.977E-06
Propene (propylene)	1.029E-07
Propionic acid (propane acid)	1.421E-12
Styrene	1.849E-14
Toluene (methyl benzene)	5.155E-07
Trimethylbenzene	2.203E-14
Xylene (dimethyl benzene)	4.733E-06
Hydrocarbons (unspecified)	4.864E-08
Methane	4.416E-03
Methane (biotic)	7.555E-09
Organic chlorine compounds	1.875E-12
Unspecified Organic Compounds	3.500E-13
VOC (unspecified)	1.281E-03
Other emissions to air	1.005E+00
Aldehydes, unspecified	1.750E-13
Exhaust	1.004E+00
Particulate Matter, unspecified	8.576E-07
Sand (Silica) (SiO2)	3.336E-09
Used air	8.996E-04
Particles to air	7.569E-04
Dust (PM10)	5.267E-06
Dust (PM2.5)	1.335E-05
Dust (Portland cement kiln)	4.684E-06
Dust (unspecified)	7.336E-04
Metals (unspecified)	1.239E-11
Unspecified Organic Chlorine Compounds	2.309E-12
Wood (dust)	8.347E-13
Radioactive emissions to air	9.491E-09
Uranium (total)	9.491E-09
Unspecified Heavy Metals	1.803E-16
Emissions to fresh water	9.509E-03
Analytical measures to fresh water	2.638E-03
Adsorbable organic halogen compounds (AOX)	1.082E-08
Biological oxygen demand (BOD)	3.152E-05

Process or Category	Gate to Gate (ECF)
Chemical oxygen demand (COD)	9.398E-05
Nitrogenous Matter (unspecified, as N)	1.835E-08
Solids (dissolved)	7.092E-04
Total dissolved organic bounded carbon	1.924E-05
Total Dissolved Solids	1.783E-03
Total organic bounded carbon	2.737E-07
Heavy metals to fresh water	1.687E-04
Aluminium	2.596E-05
Antimony	2.300E-07
Arsenic (+V)	7.791E-07
Cadmium (+II)	7.842E-08
Chromium (+III)	2.524E-09
Chromium (+VI)	1.269E-13
Chromium (unspecified)	1.281E-06
Cobalt	1.777E-11
Copper (+II)	1.094E-06
Heavy metals to water (unspecified)	1.706E-10
Iron	7.779E-05
Lead (+II)	2.512E-06
Manganese (+II)	4.042E-06
Mercury (+II)	1.303E-08
Molybdenum	2.591E-08
Nickel (+II)	1.975E-05
Selenium	9.028E-09
Silver	2.246E-07
Strontium	4.823E-07
Thallium	4.980E-13
Tin (+IV)	6.235E-11
Titanium	2.460E-09
Unspecified Substance	1.560E-12
Vanadium (+III)	7.141E-09
Zinc (+II)	3.439E-05
Inorganic emissions to fresh water	6.038E-03
Acid (calculated as H+)	1.240E-08
Aluminum (+III)	8.097E-07
Ammonia	1.543E-08
Ammonium (total N)	2.810E-04
Ammonium / ammonia	8.391E-07

Process or Category	Gate to Gate (ECF)
Barium	7.476E-05
Beryllium	2.843E-11
Boron	6.729E-07
Bromate	1.661E-14
Bromine	1.733E-12
Calcium (+II)	1.186E-04
Carbonate	5.292E-04
Chlorate	1.591E-11
Chloride	1.649E-03
Chlorine (dissolved)	1.017E-06
Copper ion (+II/+III)	1.575E-13
Cyanide	2.090E-06
Fluoride	2.419E-04
Fluorine	4.409E-10
Hydrogen chloride	7.737E-12
Hydrogen fluoride (hydrofluoric acid)	1.949E-12
Hydrogen Ions (H+)	3.482E-10
Hydroxide	9.719E-09
Inorganic salts and acids (unspecified)	7.213E-22
Magnesium (+III)	2.353E-05
Magnesium chloride	3.940E-13
Metal ions (unspecific)	7.534E-10
Neutral salts	1.314E-14
Nitrate	8.372E-06
Nitrate (as total N)	5.593E-12
Nitrogen	4.835E-06
Nitrogen (as total N)	1.409E-06
Nitrogen organic bounded	1.798E-08
Phosphate	1.123E-08
Phosphorus	2.762E-05
Potassium	3.068E-09
Silicate particles	8.596E-08
Sodium (+I)	2.794E-04
Sodium chloride (rock salt)	1.485E-03
Sodium hypochlorite	1.032E-12
Sulfates	1.114E-04
Sulphate	1.195E-03
Sulphide	1.666E-07

Process or Category	Gate to Gate (ECF)
Sulphite	1.611E-07
Sulphur	1.747E-09
Sulphuric acid	9.975E-10
Unspecified Iron Oxides	3.994E-12
Unspecified Oil	1.415E-11
Unspecified Organic Chlorine compounds	3.207E-14
Unspecified Salt	1.283E-10
Unspecified Solids (Suspended)	4.981E-10
Organic emissions to fresh water	2.556E-06
Halogenated organic emissions to fresh water	1.187E-11
1,2-Dibromoethane	3.168E-15
Chlorinated hydrocarbons (unspecified)	6.512E-18
Chloromethane (methyl chloride)	1.185E-11
Dichloroethane (ethylene dichloride)	8.388E-19
Dichloropropane	1.752E-16
Polychlorinated dibenzo-p-dioxins (2,3,7,8 - TCDD)	3.959E-20
Vinyl chloride (VCM; chloroethene)	1.812E-14
Hydrocarbons to fresh water	2.239E-06
Acenaphthene	2.731E-12
Acenaphthylene	1.141E-12
Acetic acid	4.758E-10
Acrylonitrile	1.281E-11
Anthracene	4.034E-12
Aromatic hydrocarbons (unspecified)	2.310E-09
Benzene	5.608E-09
Benzo{a}anthracene	3.858E-13
Benzofluoranthene	1.947E-13
Chrysene	1.710E-12
Cresol (methyl phenol)	4.525E-11
Ethyl benzene	2.901E-10
Fluoranthene	4.453E-13
Hexane (isomers)	4.942E-12
Hydrocarbons (unspecified)	1.943E-06
Methanol	2.333E-07
Oil (unspecified)	3.653E-08
Phenol (hydroxy benzene)	5.329E-09
Polycyclic aromatic hydrocarbons (PAH, unspec.)	7.166E-09
Toluene (methyl benzene)	3.589E-09

Process or Category	Gate to Gate (ECF)
Xylene (isomers; dimethyl benzene)	1.619E-09
Carbon, organically bound	3.086E-07
Naphthalene	1.767E-10
N-unspecified (N)	1.107E-11
Organic chlorine compounds (unspecified)	2.920E-13
Organic compounds (dissolved)	1.202E-10
Organic compounds (unspecified)	3.361E-11
Unspecified wastewater	8.374E-09
Other emissions to fresh water	0.000E+00
Particles to fresh water	6.624E-04
Metals (unspecified)	6.767E-11
Silicon dioxide (silica)	4.357E-17
Soil loss by erosion into water	2.864E-11
Solids (suspended)	6.624E-04
Suspended solids, unspecified	4.813E-10
Unspecified Oxides	3.320E-12
Radioactive emissions to fresh water	0.000E+00
Bromide	0.000E+00
Radionuclide	0.000E+00
Sulfite	0.000E+00
Unspecified Solids (Dissolved)	9.601E-10
Uranium (total)	0.000E+00
Emissions to sea water	3.252E-04
Analytical measures to sea water	1.398E-06
Adsorbable organic halogen compounds (AOX)	8.840E-14
Biological oxygen demand (BOD)	9.751E-08
Chemical oxygen demand (COD)	1.203E-06
Total organic bounded carbon	9.751E-08
Heavy metals to sea water	2.704E-07
Arsenic (+V)	3.297E-09
Cadmium (+II)	2.413E-09
Chromium (unspecified)	5.289E-09
Cobalt	4.150E-10
Copper (+II)	1.006E-08
Iron	1.668E-08
Lead (+II)	2.623E-09
Manganese (+II)	1.672E-09
Mercury (+II)	3.735E-11

Process or Category	Gate to Gate (ECF)
Molybdenum	9.004E-11
Nickel (+II)	3.328E-09
Silver	2.672E-10
Strontium	2.157E-07
Tin (+IV)	3.200E-10
Titanium	3.259E-11
Vanadium (+III)	3.253E-10
Zinc (+II)	7.915E-09
Inorganic emissions to sea water	2.458E-04
Aluminum (+III)	1.049E-09
Ammonia	3.118E-08
Barium	4.715E-08
Beryllium	1.874E-11
Boron	1.697E-08
Calcium (+II)	1.853E-06
Carbonate	2.966E-06
Chloride	2.367E-04
Magnesium	4.643E-07
Nitrate	3.844E-09
Sodium (+I)	1.947E-06
Sulphate	1.252E-06
Sulphide	5.399E-07
Sulphur	9.079E-09
Organic emissions to sea water	1.468E-07
Hydrocarbons to sea water	1.459E-07
Acenaphthene	2.152E-11
Acenaphthylene	8.397E-12
Acetic acid	2.866E-11
Anthracene	1.215E-11
Aromatic hydrocarbons (unspecified)	9.751E-10
Benzene	1.604E-08
Benzo{a}anthracene	4.381E-12
Benzofluoranthene	4.407E-12
Chrysene	2.383E-11
Cresol (methyl phenol)	2.352E-10
Ethyl benzene	9.116E-10
Fluoranthene	5.107E-12
Hexane (isomers)	2.567E-11

Process or Category	Gate to Gate (ECF)
Oil (unspecified)	9.709E-08
Phenol (hydroxy benzene)	1.612E-08
Toluene (methyl benzene)	1.047E-08
Xylene (isomers; dimethyl benzene)	3.945E-09
Naphthalene	9.004E-10
Particles to sea water	7.760E-05
Solids (suspended)	7.760E-05
Emissions to agricultural soil	0.000E+00
Emissions to industrial soil	1.092E-06
Heavy metals to industrial soil	2.707E-07
Arsenic (+V)	3.366E-13
Cadmium (+II)	3.548E-12
Chromium (+III)	9.402E-13
Chromium (unspecified)	7.632E-10
Cobalt	1.288E-11
Copper (+II)	7.988E-12
Iron	1.044E-09
Lead (+II)	1.601E-12
Manganese (+II)	2.103E-10
Mercury (+II)	2.315E-14
Nickel (+II)	4.052E-10
Strontium	2.681E-07
Zinc (+II)	9.111E-11
Inorganic emissions to industrial soil	8.168E-07
Aluminum (+III)	8.799E-10
Ammonia	4.155E-07
Bromide	1.104E-10
Calcium (+II)	2.673E-08
Chloride	1.303E-07
Fluoride	3.680E-09
Magnesium (+III)	3.695E-09
Phosphorus	4.363E-08
Potassium (+I)	9.526E-08
Sodium (+I)	2.338E-09
Sulphate	1.351E-08
Sulphide	8.108E-08
Organic emissions to industrial soil	4.056E-09
Oil (unspecified)	4.056E-09

Process or Category	Gate to Gate (ECF)
Radioactive emissions to industrial soil	0.000E+00
Calcium Fluoride	0.000E+00
Radionuclide	0.000E+00

Embedded Unit Processes

NETL (2010). *NETL Life Cycle Inventory Data – Unit Process: Dry Mill Ethanol Plant Operation.* U.S. Department of Energy, National Energy Technology Laboratory. Last Updated: February 2010 (version 01). www.netl.doe.gov/energy-analyses (http://www.netl.doe.gov/energy-analyses)

References

None.

Section III: Document Control Information

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Point of Contact: Timothy Skone (NETL), Timothy.Skone@NETL.DOE.GOV

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