Glossary of Key Terms

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Agricultural baseline – Building on both the USDA 2015 baseline and the agricultural census data (USDA NASS 2014), this baseline scenario was developed using POLYSYS (see chapter 2 and volume 1, appendix C). This is the reference case for the *BT16* volume 1 agricultural scenarios. The agricultural baseline runs from 2015 through 2040.

Agricultural residues – Aboveground biomass produced as byproducts of conventional crops. Crop residues modeled in *BT16* volume 1 include: barley straw, corn stover, oat straw, sorghum stubble, wheat straw.

Agriculture scenarios – Also called exogenous price simulations or "specified -price" simulations - For the purpose of *BT16* volume 2, these include a base-case scenario with a 1% annual yield increase for energy crops, (referred to as "BC1") and a high-yield scenario with 3% annual yield increase for energy crops (referred to as "HH3"), among other scenario-specific assumptions (see volume 1 chapter 4 and appendix C, as well as volume 2 chapter 2).

Algae co-location scenarios – For the purposes of *BT16* volume 2, these scenarios include open-pond algal biomass production that may be associated with select resource co-location opportunities to utilize carbon dioxide (CO_2) from ethanol plants, coal power plants, and natural gas plants. Biomass, and price ranges for that biomass, are estimated for *Chlorella sorokiniana* (a freshwater strain) and *Nannochloropsis salina* (a saline strain).

ANPP – aboveground net primary productivity – Linked to the energy flow in ecosystems and important for global carbon estimates, ANPP is sometimes referred to as plant yield and is the rate of storage of organic matter in plant tissues in excess of the respiratory utilization by plants. (Definition adapted from Odum E., 1971. Fundamentals of Ecology, Saunders: Philadelphia).

Biodiversity – biological diversity – Variability among living organisms from all sources and the ecological complexes of which they are part; this includes diversity within species, between species and of an ecosystem. (Definition adapted from the United Nations Convention on Biological Diversity as cited in ISO, 2015. 13065:2015 - Sustainability Criteria for Bioenergy).

Bioeconomy – From a broad economic perspective, the bioeconomy refers to the set of economic activities relating to the invention, development, production and use of biological products and processes. (Definition adapted from OECD, 2016. The Bioeconomy to 2030: designing a policy agenda).

Bioeconomy AGE – Bioeconomy Air and Greenhouse Gas Emissions – This model estimates the energy, air quality, and GHG impacts of the Billion-Ton Bioeconomy cases compared with an all fossil baseline.

Bioenergy – Energy derived from biomass.

Biofuels – Fuels made from biomass resources, or their processing and conversion derivatives. Biofuels include ethanol, biodiesel, and methanol among others.

Bioindicator – Species or group of species whose function, population, or other characteristics can reveal environmental conditions such as pollutants.

Biopower – The use of biomass feedstock to produce electric power or heat through direct combustion of the feedstock, through gasification and then combustion of the resultant gas, or through other thermal conversion processes. Power is generated with engines, turbines, fuel cells, or other equipment.

Biomass sorghum – An annual herbaceous crop, currently grown in rotation throughout the Southeast and Great Plains for grains and forage. Biomass sorghum exhibits non-photoperiod sensitivity and drought tolerance. For the purposes of *BT16* analyses, this term depicts any variety of sorghum developed for high biomass yields, and neither for grain nor sugar content. Budgets for biomass sorghum under *BT16* volume 1 can represent biomass sorghum, forage sorghum, or sweet sorghum. Modeled yields represent either biomass or forage sorghum; the variety with the highest productivity in a certain region was used in the agriculture scenarios.

Biomass supply scenarios – For the purpose of *BT16* volume 2 analyses, this term denotes an empirically modeled scenario with combined agriculture forestry resources.

BMP – Best Management Practice –The practice, or combination of practices, that is determined to be an effective and practicable (including technological, economic, and institutional considerations) means of achieving a given goal (Definition adapted from North Carolina Forest Service, Best Management Practices: What are BMPs). Often the goal associated with BMPs is conservation of resources, and so this term is often used within the context of environmental management.

BTB – Billion-Ton Bioeconomy – The evaluation of potential benefits of using biomass to produce fuel, power, and chemicals as compared to fossil-derived feedstocks.

Bulk density – An indicator of soil compaction, bulk density describes the weight of a material (e.g., soil) divided by its volume. Grams per cubic centimeter are generally used as units of measurement. (Definition adapted from the U.S. Department of Agriculture's Natural Resources Conservation Service).

CDL – Cropland Data Layers – A product of the United States Department of Agriculture, National Agricultural Statistics Service, Research and Development Division, Geospatial Information Branch, Spatial Analysis Research Section with the scope to "use satellite imagery to provide acreage estimates to the Agricultural Statistics Board for the state's major commodities and to produce digital, crop-specific, categorized geo-referenced output products." (Definition from USDA NASS, 2016. FAQ CropScape and Cropland Data Layers).

Clear-cut /clearcut – General term used to denote a type of forest harvest in which every tree has been cut down during a logging operation, but which in practice means that a few trees of non-commercial value are left standing.

CLU – Common Land Unit – The smallest unit of land that has a permanent, contiguous boundary, a common land cover and land management, a common owner and a common producer in agricultural land associated with USDA farm programs. CLU boundaries are delineated from relatively permanent features such as fence lines, roads, and/or waterways. (Definition adapted from USDA Farm Service Agency, Aerial Photography, Imagery Products).

CO_2 – carbon dioxide – A colorless, odorless noncombustible gas with the formula CO2 that is present in the atmosphere. It is formed by the combustion of carbon and carbon compounds (such as fossil fuels and biomass), by respiration, which is a slow combustion in animals and plants, and by the gradual oxidation of organic matter in the soil. (Definition adapted from DOE EERE, 2016. Glossary of Energy-Related Terms).

CO_{2e} - carbon dioxide equivalent – The equivalent CO2 concentration to measure global warming potential of a given greenhouse gas (e.g., methane, nitrous oxide).

CO_2 fertilization – This is theoretical principle associated with climate change science describing the fertilization of plants that use CO_2 in photosynthesis from increased CO_2 in the atmosphere.

CO – carbon monoxide – A toxic, colorless, odorless, and tasteless gas, CO is produced in the incomplete combustion of carbon and carbon compounds such as fossil fuels (i.e. coal, petroleum) and their products (e.g. liquefied petroleum gas, gasoline), and biomass. (Definition adapted from DOE EERE, 2016. Glossary of Energy-Related Terms).

Conservation – To reduce or avoid the consumption of a resource or commodity. (Definition adapted from DOE EERE, 2016. Glossary of Energy-Related Terms).

Consumptive water use – A key parameter for water depletion (see ISO, 2015. 13065:2015 - Sustainability Criteria for Bioenergy), this term refers to the use of water for a process (e.g., industrial or agricultural irrigation).

Conventional crop – Under the *BT16* analyses, conventional crops are known as the primary U.S. commodity crops, such as barley, corn, cotton, hay, oats, rice, sorghum, soybeans, and wheat are considered conventional crops.

Conventional tillage – System using soil tillage to turn the soil (e.g., with a chisel plow and an offset disk) and prepare a field for planting. This "traditional" practice helps to control for weeds and pests and traditionally involves burying crop residues.

Conventional wood – Roundwood, whole-tree chips, or wood residues that are used for the production of wood pulp (also referred to as pulpwood), or dimension lumber, or construction products.

Conversion – A fundamental change in form, character, or function. Can refer to chemical conversions (e.g., biomass feedstocks to biofuel and bio-based chemical products), or land conversion (e.g., the process of first-time conversion of a high-canopy forest to a human-managed landscape for agriculture and settlement).

CORRIM – Consortium for Research on Renewable Industrial Materials – This organization provides data for LCA analyses with a focus on the "environmental impact of the production, use, and disposal of wood and other bio-based materials." CORRIM regions include Northeast, North Central, South, Inland West, and Pacific Northwest. (Definition adapted from CORRIM, 2016. Our Mission. Accessed from http://www.corrim.org/).

Cropland – Similar to the 2012 USDA Census of Agriculture definition of "total cropland," this land category includes planted and harvested acres of corn, wheat, grain sorghum, barley, soybeans, rice, cotton, and hay (see Natural Resources Conservation Service definition of cropland and *BT16* volume 1 appendix C for more details). Under some definitions, cropland can also include subcategories cropland pasture (cropland used as pasture), as well as idle cropland (as defined by USDA for the Census of Agriculture) and Conservation Reserve Program lands, but for the purposes of *BT16* analyses, these lands are excluded from the cropland base. Note: County-level distribution is determined by a multi-year average of production from 2010-2013 USDA National Agricultural Statistics Service surveys of agricultural production. It is assumed to be a total 312.6 million acres in the initial simulation year of agricultural production in 2015. (See *BT16* volume 1, appendix C for more details).

Cropland pasture, or cropland used for pasture or grazing – Defined in the 2012 USDA Census of Agriculture appendix B as "land used only for pasture or grazing that could have been used for crops without additional improvement. Also included are acres of crops hogged or grazed but not harvested prior to grazing" (Adapted from the U.S. Department of Agriculture). Note: It is assumed to be a total 11.2 million acres across the projection period. (See *BT16* volume 1, appendix C for more details).

CRP – Conservation Reserve Program – A land conservation program administered by the Farm Service Agency (FSA) that pays a yearly rental payment in exchange for farmers removing environmentally sensitive land from agricultural production and planting species that will improve environmental quality. (Definition from U.S. Department of Agriculture FSA Conservation Programs).

Dedicated energy crops – Poised to complement the process to further commercialize biofuels, biopower, and bioproducts, these crops can improve supply security and help control feedstock quality characteristics. Under the *BT16* analyses, these include energy cane, biomass sorghum, switchgrass, miscanthus, and short-rotation woody crops (eucalyptus, pine, poplar, and willow).

DBH – diameter at breast height – The common measure of wood volume approximated by the diameter of trees measured at approximately breast height from the ground.

EF – emission factor – A measure of the average amount of a specified pollutant or material emitted for a specific type of fuel or process. (Definition adapted from DOE EERE, 2016. Glossary of Energy-Related Terms).

Elasticity of demand – The ratio of the percentage change in the quantity of a good or service demanded to the percentage change in the price. (Definition adapted from DOE EERE, 2016. Glossary of Energy-Related Terms).

Energy cane – A perennial tropical grass with high yield potential across the Gulf South. Low-sugar, high-cellulose varieties (a hybrid of commercial and wild sugar cane species) can be established, managed, and harvested using existing sugar-cane industry equipment.

Enterprise budgets – Financial management tools used by farmers to estimate costs and returns from farm operations.

Environmental indicator – Quantitative variable that can be measured and which provides information about potential or realized environmental effects of human activities on phenomena of concern. For the purposes of *BT16*, environmental indicators, combined with social and economic indicators measure sustainability of bioenergy.

ET – Evapotranspiration – The simultaneous process of evaporation of water from the earth's surface to the atmosphere and transpiration from plants.

Eucalyptus – A short-rotation woody crop ideal for Gulf States as well as Georgia and South Carolina.

Extractable phosphorus (P) – Indicates the amount of available P for plants. Phosphorus is considered one of the most important soil nutrients in typical productive land management systems. (Definition adapted from McBride et al., 2011. Indicators to support environmental sustainability of bioenergy systems. doi:10.1016/j.ecolind.2011.01.010).

Farmgate – Denoting sector of the bioenergy or bioproduct supply chain for agricultural products: after harvest, ready for delivery to a processing facility.

Farm Resource Regions - FRRs – 13 regions used by the POLYSYS model and based on the nine USDA regions carrying the same name.

Feedstock – Raw material for a process (e.g., industrial). Biomass feedstocks are the plant and algal materials used to derive fuels like ethanol, butanol, biodiesel, and other hydrocarbon fuels. (Definition adapted from DOE EERE, 2016. Glossary of Energy-Related Terms).

Filter strip – A strip or material, usually vegetation, used to separate material (e.g., organic matter, vegetation, or other pollutants) from water. (Adapted from USEPA, 2010. Guidance for Federal Land Management in the Chesapeake Bay Watershed, Glossary).

FIA – Forest Inventory and Analysis – A program of the U.S. Forest Service of the U.S. Department of Agriculture that collects, analyzes, and reports information on the status and trends of America's forests: how much forest exists, where it exists, who owns it, and how it is changing. It has been in continuous operations since 1928. The latest technologies are used to acquire a consistent core set of ecological data about forests through remote sensing and field measurements. The data in this report are summarized from more than 100,000 permanent field plots in the United States.

Forest land – Land at least 10% stocked by forest trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. (Definition adapted from the U.S. Forest Service of the U.S. Department of Agriculture).

Forestry scenarios – Also called specified-biomass demand levels or "specified-demand" simulations – For the purpose of *BT16* volume 2, these include a baseline scenario with moderate housing -- low wood energy demand (referred to as "ML") and a scenario with high housing-high wood energy demand ("HH"), among other scenario-specific assumptions.

ForSEAM – **Forest Sustainable and Economic Analysis Model** – a linear programming model used to estimate potential forestry feedstocks in *BT16*.

Fuelwood – Wood used for conversion to some form of energy, primarily for residential use but also has industrial applications (e.g., steel and alloy production in developing countries).

Grasslands – Defined by land cover and also by land use. Under land cover, grasses are dominant in grasslands but plants may also include legumes, forbs, shrubs and, in some locations, sparse tree cover (up to 10% canopy before classification is changed). Thus, grassland cover can include woody plants, grasses and forbs - herbs or non-woody flowering plants that are not grass species. In terms of land use, grasslands can be defined by grazing, haying, and other forms of forage harvest. By these definitions, grassland encompasses a wide variety of grassland types from minimally managed or nearly "natural" grasslands to grassland that was seeded or improved and actively managed for forage production to feed livestock.

GHG – greenhouse gas – Natural or anthropogenic gas that can absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the earth's surface, the atmosphere, and the clouds. Water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. (Adapted from the Intergovernmental Panel on Climate Change, 2007. Working Group I: The Physical Science Basis).

Grower payment – Payment to the landowner for the value of standing biomass and rights to harvest biomass, equivalent to "stumpage price" as used in the forest industry (grower payment plus the cost of harvest equals the farmgate price).

Growing stock – A classification of timber inventory that includes live trees of commercial species meeting specified standards of quality or vigor. Cull trees are excluded. When associated with volume, growing stock includes only trees 5.0 inches dbh and larger.

GDP – gross domestic product – A primary indicator of the state of an economy, it is a measure of the value of all goods and services within a given timeframe.

Herbicide concentration (in streams and export) – A measure of the amount (g) of herbicides in a given volume (L) of water extracted from a waterbody (e.g., stream or surface water when considering export or runoff). This is considered an important test to assess the exposure of aquatic life to chemicals, and the potential toxic effects on aquatic life. (Definition adapted from McBride et al., 2011. Indicators to support environmental sustainability of bioenergy systems. doi:10.1016/j.ecolind.2011.01.010).

Housing starts – Used as an indicator of economic conditions, this term represents the number of privately owned new housing construction projects begun in a given year.

ILUC -- Indirect land-use change – Roundabout course or path that modifies human actions of using land, or human purpose(s) of land, or management of natural resources, or benefits derived from natural resources.

Indirect – Not in a direct course or path; roundabout; resulting otherwise than directly or immediately, as "indirect effects or consequences."

Infiltration – Process by which surface level water enters the soil.

Land class – A descriptor for a predominant vegetation feature in a defined land area. LUC models commonly consider a simplified global map with major land classes such as forest, grassland, cultivated cropland, and other (including developed).

Land cover – The physical appearance of the land surface based on a classification system (e.g., forests, grasslands) (Definition from Turner and Meyer, 1994. Global Land-Use/Land-Cover Change: Towards an Integrated Study). Note: change in land cover reflects a shift based on a defined cover classes, regardless of land use. Changes in land-cover classification can result from how data are interpreted or aggregated, the resolution of analysis, threshold definitions for predominant cover, the ontology applied, the scale and order of land cover class analysis, as well as from actual physical changes that cross the threshold values that define a given land-cover class.

Land management –The process of dealing with or controlling the use and development of land resources. Tillage is an example of agricultural land management.

Land use – Human management of terrestrial resources, designated purpose of those resources, or benefits derived from those resources (land use may involve vegetation, animals, soil, groundwater, streams, wetlands, minerals, air flow, and other resources).

LUC – land-use change – Modification of the human actions of using land, or human purposes of land (e.g. zoning), or human management of natural resources, or benefits derived from natural resources.
Note: Almost anything humans do, or dictate, or refrain from doing, that impacts land and related natural resources, could be considered LUC.

LCC – land capability class – A USDA classification system based on soil productivity for common agricultural crops.

Land rent – A payment to the land owner for production (usually agricultural or forestry) on that land.

LAI – leaf area index – The total one-sided area (m^2) of photosynthetic tissue per unit ground surface area (m^2). (Definition from Gobron, 2016. Leaf Area Index, FAO).

Load (or loading) – Quantity delivered to a water body. Synonymous with yield (nutrient yield, water yield). Term is usually used for sediment or nutrients.

Logging residues – The unused portions of growing-stock and non-growing-stock trees cut or killed by logging and left in the woods.

Marginal cost –The added cost of producing one additional unit of an item.

Marginal land (see also degraded-, idle-, underutilized-, etc.) – Relative term that varies widely by country, institution and local conditions. In traditional economics, land is marginal if the combination of yields and prices barely covers cost of production. In practice, the term is generally used more broadly to describe any lands that are not in productive use, presumably due to their low potential productivity, in contrast to other lands yielding rents from services. Depending on time and place, marginal land may also refer to idle, underutilized, barren, inaccessible, degraded, rocky, excess and abandoned lands, or to lands occupied by politically and economically marginalized populations, or land with characteristics that make a particular use unsustainable or inappropriate. Furthermore, the classification of marginal lands by remote means (using satellite imagery or land-cover data sets) involves multiple sources of large uncertainty. For example, what may be seen from above as idle lands may actually be fallow land between cropping regimes, recently harvested lands, or areas that are being mismanaged. (Definition from CBES, 2009. Land-Use Change and Bioenergy: Report from the 2009 workshop, ORNL/CBES-001 USDOE ORNL).

Minimum base flow – A minimum portion of stream water that results from non-runoff sources (e.g., seepage of groundwater). This is a constant, regardless of stream-height. (Adapted from Santhi, 2008. doi:10.1016/j.jhydrol.2007.12.018).

Miscanthus – A sterile triploid with low nutrient requirements and wide adaptability across cropland.

NEI -- National Emissions Inventory – The official United States' air pollutant emissions inventory.

Net change in total area planted in a given crop – The net change in the total areas managed for a specific crop type (e.g., corn) in a defined simulation; calculated by comparing results from two simulations. Note: aggregate or average values were used in assessing net change; a multitude of crop transitions could occur involving crops even if they do not reflect a net change in area.

NH_3 – ammonia – A colorless, pungent, gas (NH3) that is extremely soluble in water, may be used as a refrigerant; a fixed nitrogen form suitable as fertilizer. (Definition adapted from DOE EERE, 2016. Glossary of Energy-Related Terms).

No-till – Describes the process of planting without using conventional tilling processes (e.g., substituting a drill for plow or disk tillage) and is considered an important conservation practice. (Definition adapted from USDA NRCS).

Nonattainment area – Any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant. (Definition adapted from EPA, 2016. Air Quality Planning & Standards, Air Quality).

Non-stationarity – The probability distributions of stochastic processes change with shifts in time and in effect, the process of interest is not in a state of statistical equilibrium.

NO_x - nitrogen oxide - Compounds of nitrogen and oxygen, or a mixture of such compounds.

Nutrient loading – A measure of pollution, this term describes the nutrients in a system (e.g., water body) at a given time.

Ozone precursors – Describes a set of gasses (NOx, CO, and non-methane VOCs - volatile organic compounds) that participate in the chemical reaction to produce ozone in the lower atmosphere (O_3 or tropospheric ozone), a harmful type of pollution. (Definition adapted from USDA NRCS, 2012. Resource Concerns: Air, Ozone Precursors).

Pastureland, all – A category not explicitly defined in the 2012 USDA Census of Agriculture, but estimated as the reported composite category of cropland used as pasture, permanent pasture, woodland pasture, rangeland, irrigated pastureland, and wasteland in the 2012 USDA Census of Agriculture. It is assumed to be a total 446.3 million acres across the projection period across the *BT16* simulations (i.e. BC1 and HH3).. (See *BT16* volume 1, appendix C).

Perennial grasses – A grass that lives for more than two years.

Permanent pasture – Grazable land that does not qualify as woodland pasture or cropland pasture (per USDA census definition; see volume 1 appendix C and volume 2 chapter 3 for discussion of how pasture was classified for *BT16* projections). Note: This land class may be irrigated or dry land. In some areas, it can be a high quality pasture that could not be cropped without improvements. In other areas, it is barely able to be grazed and is only marginally better than wasteland. It is assumed to be a total 402 million acres across the projection period.

Pine – Also referred to as "southern pine" – A tree representing the major commercial tree crop in the South, with 32 million acres of plantations (Fox, Jokela, and Allen 2007). This crop can be adapted to grow in high density on agricultural land assuming 8-year rotations.

PM – particulate matter – Considered pollution, PM is a mixture of extremely small particles and liquid droplets suspended in the air. (Definition adapted from USEPA, 2016. Particulate Matter (PM) Pollution).

$PM_{2.5}$ - Total particulate matter less than 2.5μm diameter.

PM_{10} - Total particulate matter less than 10μm diameter. **POLYSYS** – Policy Analysis System – An agricultural policy modeling system of U.S. agriculture, including both crops and livestock. It is based at the University of Tennessee Institute of Agriculture, Agricultural Policy Analysis Center.

Poplar – A short-rotation woody crop with great potential in the Lake States, the Northwest, the Mississippi Delta, and other regions.

Price elasticities – Responsiveness of supply or demand to changes in price.

NOx - nitrogen oxides – Nitrogen dioxide and nitric oxide.

reduced-till – Managing the amount, orientation, and distribution of crop and other plant residue on the soil surface year-round while limiting soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting. (Source USDA NRCS, 2016. Conservation Practice Standard, Code 345).

Residue – The portion of a crop (agriculture or forestry) remaining after the primary product is harvested.

RFS – Renewable Fuel Standard – The RFS was established by the Energy Policy Act of 2005. It required 7.5 billion gallons of renewable-based fuel (which was primarily ethanol) to be blended into gasoline by 2012. This original RFS (referred to sometimes as RFS1) was expanded upon (RFS2) by the Energy Independence and Security Act of 2007 (EISA) to include diesel in addition to gasoline as well as to increase the volume of renewable fuel to be blended into fossil-based fuel to 9 billion and ultimately 36 billion gallons by 2022. RFS2 established life-cycle greenhouse gas requirements (less than fossil fuels they replace) for renewable fuels.

Riparian buffer – A section of ecosystem (traditionally terrestrial and sometimes aquatic) along a water body that is used to protect the aquatic ecosystem from impacts of adjacent land uses. Benefits of riparian buffers can include bank stabilization and reduction of non-point source pollution (e.g., nutrient loading) and can depend on their extent and composition. Inclusion of riparian buffers is considered a best management practice and single component of a comprehensive watershed management plans. (Definition adapted from Mayer 2006, EPA/600/R-05/118).

RISI – Pulp and Paper Industry Intelligence – Organization that produces the international wood fiber report, an annual report that "examines the markets for globally traded pulpwood fiber and the pulpwood resources for domestic and export supply in more than 35 countries." (Definition adapted from RISI, 2016. www.risiinfo.com).

Roadside – Denoting sector of the bioenergy or bioproduct supply chain for forestry products: after harvest, ready for delivery to a processing facility.

RUSLE2 – Revised Universal Soil Loss Equation version 2 – A computer program that estimates erosion and sediment delivery for conservation planning in crop production.

SCSOC – Surrogate CENTURY Soil Organic Carbon model – Uses calculations and parameters from CENTURY, a soil organic matter model, to estimate SOC changes based on local conditions like crop yield, soil type, and weather data.

Sediment yield – Term is usually used for water and describes the quantity of sediment delivered to a water body. Synonymous with sediment load or loading.

SOC – soil organic carbon – One of the most important soil quality indicators, this term refers to the carbon (C) stored in soils. (Adapted from: Reeves 1997 The role of soil organic matter in maintaining soil quality in continuous cropping systems.; McBride et al., 2011. Indicators to support environmental sustainability of bioenergy systems. doi:10.1016/j.ecolind.2011.01.010).

Soil pH – A measure of soil acidity or alkalinity and a common indicator of soil health due to impact on crop yields, plant nutrient availability, and microorganism activity. (Definition adapted from USDA NRCS, 2011. Soil Quality Indicators).

SO_x – sulfur oxides – Compounds of sulfur and oxygen. Sulfer Dioxide (SO_2) is considered the greatest concern for human health and the environment. (Definition adapted from USEPA, 2016. Sulfur Dioxide (SO_2) Pollution).

SRWC – short-rotation woody crop – Intensively managed, fast-growing species that are purpose-grown in a plantation system with the primary intent to use the wood for bioenergy, biofuels, bioproducts, pulpwood, or, in some limited cases, for lumber. These energy crops produce large amounts of biomass over a short period of time, usually less than 10 years. Depending on the species and the production method, harvest frequency can occur in as little as three years per coppice cycle. For the purpose of *BT16* analyses, these include non-coppice (loblolly pine and poplar) and coppice (eucalyptus and willow) species. (USDOE 2011, Billion Ton Update).

Storm flow – Runoff or flow of water due to a rainfall or storm event.

Strip-harvest – Alternating cut and uncut sections when harvesting a field or forest. **Stumpage price** – The price paid for the right to harvest standing timber ("on the stump") on a given piece of land.

Sustainability – Aspirational concept denoting the capacity to meet current needs while maintaining options for future generations to meet their needs. To make the concept of sustainability operational, consistent approaches are required that facilitate comparable, science-based assessments using measurable indicators of environmental, economic, and social processes (Hecht et al. 2009 .Good policy follows good science: using criteria and indicators for assessing sustainable biofuels production.; McBride et al. 2011 doi:10.1016/j.ecolind.2011.01.010; Dale et al. 2015 DOI: 10.1002/bbb.1562). Notes: Conceptual sustainability and sustainable development goals are described in the Brundtland Report (1987) and the National Environmental Policy Act (U.S. Government 1969), the latter of which committed "to create and maintain conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations." Sustainability does not imply a steady state or an absolute value, but instead is a relative and comparative term that must have a defined context, based on clear objectives (Efroymson et al. 2013. doi: 10.1007/s00267-012-9907-5).

Suspended sediment concentration (in streams and export) – A measure of the amount (g) of sediment in a given volume (L) of water extracted from a waterbody (e.g., stream or surface water when considering export or runoff).

Switchgrass – A model perennial native grass, with wide range and potential distribution.

Taxon of special concern – A taxonomic category or group (e.g., species, genus), varying in identity and number by site and region, with value (intrinsic or other) in which there is special concern related to the continuation of that taxon. Term relates to the Species of Special Concern designation, which has varying legal definitions, but which generally means an extremely uncommon species (but not legally designated as endangered or threatened) with unique or highly specific habitat requirements. An indicator of biodiversity, taxa of concern can include rare native species, but also species of commercial value, cultural importance, or recreational value. Taxa of special concern can also be keystone species or those whose impact on the ecosystem is disproportionately large relative to its abundance. (Definition adapted from McBride et al., 2011. Indicators to support environmental sustainability of bioenergy systems. doi:10.1016/j.ecolind.2011.01.010).

Thinning from above - The removal of trees from the dominant and codominant crown classes in order to favor the best trees of those same crown classes. Interchangeable terms: crown thinning, high thinning. (Definition adapted from Adams, et al. 1994. Silviculture Terminology, SAF).

Tillage flexibility index – A flexibility constraint is included in POLYSYS to control switching between tillage classes (tillage production distribution (CTIC 2007. National Crop Residue Management Survey) categories of management: no-till production, reduced tillage, conventional tillage) among each individual crop.

Timberlands – Forest land that is producing or is capable of producing crops of industrial wood, and that is not withdrawn from timber utilization by statute or administrative regulation. Areas qualifying as timberland are capable of producing more than 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included. (See also *BT16* volume 1 glossary).

Tolerable soil loss – An erosion factor important to the soil loss equation for conservation planning, this is the maximum amount of soil loss (tons per acre per year) tolerated while still permitting a high level of crop productivity to be sustained economically and indefinitely. (Definition adapted from RUSLE, 2002. T Value, Institute of Water Research, Michigan State University).

Total factor productivity – A measurement of the contribution of all inputs in production: total agricultural output per unit of total agricultural inputs.

Total nitrogen (N) – An essential nutrient for plants and animals, this compound (sum of ammonia, organic and reduced nitrogen, and nitrate-nitrite) is considered a contaminant when found in excess amounts. In waterways, excessive total N can lead to low levels of dissolved oxygen and negatively alter plant and aquatic life. (Definition adapted from USEPA, 2013. Total Nitrogen).

Total phosphorus (P) concentration in streams (and export) – A measure of the amount (g) of Phosphorus in a given volume (L) of water extracted from a waterbody (e.g., stream or surface water when considering export or runoff).

Traditional perennial crops – Pasture, hay, and cropland pasture that persists for two or more years.

USDA 2015 (agricultural) baseline – Agricultural projections to 2024 developed by the US Department of Agriculture. Commonly referred to as "USDA Baseline" in Billion Ton studies. (Definition from USDA Agricultural Projections No. (OCE-2016-1) 99 pp, February 2016; National Agricultural Statistics Service Agricultural Statistics 2015).

USFPM – The U.S. Forest Products Module – A partial market equilibrium model of the U.S. forest sector that operates within the Global Forest Products Model (GFPM) to provide long-range timber market projections in relation to global economic scenarios. (Definition adapted from USDA Forest Service, 2011. U.S. forest products module: a technical document supporting the Forest Service 2010 RPA Assessment).

VWC – virtual water content – The volume of water used in production of a good or service. (Adapted from Allan, 1993. Fortunately there are substitutes for water otherwise our hydro-political futures would be impossible).

VOC – volatile organic compound – A variety of organic chemicals that are emitted as gases from solids or liquids. (Definition adapted from EPA . 2016. Volatile Organic Compounds' Impact on Indoor Air Quality.).

Water footprint analysis – Method to quantify the consumptive water use during the production of a product (e.g., biomass).

Water intensity – Gallons of water consumed to produce a unit of feedstock or the amount of water consumed from an acre of land for feedstock production annually.

Water yield – The total outflow from all or part of a drainage basin through either surface channels or subsurface aquifers within a given time (e.g., one year).

Whole-tree harvest – There are four combinations of harvest methods and intensity for whole trees: 1) full-tree clear cut, 2) full-tree thinning, 3) cut-to-length clear cut, and 4) cut-to-length thinning. The full-tree method can use the entire tree, including branches and tops. The cut-to-length method harvests logs only, leaving logging residue behind. For both methods, the intensity can be either clear cut or thinning. Clear cutting removes all of the standing trees in a selected area. Thinning removes part of the standing trees in a selected area.

Willow – A short-rotation woody crop assumed to be managed on a 20-year cycle and harvested at 4-year growth stages. It is being commercialized widely in the Northeast.

Wood pellets – Generally made from compacted forestry residues (e.g., sawdust and industrial waste), these are the most common type of pellet fuel and are included in the BT16 advanced supply system analyses.

List of Acronyms

BU -- Bushels

DOE – United States Department of Energy

EISA – The Energy Independence and Security Act of 2007

EPA – United States Environmental Protection Agency

FPEAM – Feedstock Production Emissions to Air Model

GFPM – Global Forest Products Model

GREET® - Greenhouse gases, Regulated Emissions, and Energy use in Transportation model

HRU – Hydrologic Response Unit

ISO – International Organization for Standardization

MODIS – Moderate Resolution Imaging Spectroradiometer

NASS – National Agricultural Statistics Service

NAAQS – National Ambient Air Quality Standards

NOAA - National Oceanic and Atmospheric Administration

NRCS – Natural Resource Conservation Service

OAI – Ogallala Aquifer Initiative

SO_x - oxides of sulfur

PBR – photobioreactors

PRISM-EM – Parameter-elevation Relationships on Independent Slopes Model (PRISM) Environmental-Model

SCI – the Soil Conditioning Index

SCM – Supply Characterization Model

SSURGO – Soil Survey Geographic Database

Sun Grant RFP – Sun Grant Regional Feedstock Partnership

SWAT - Soil Water Analysis Tool

USDOE – U.S. Department of Energy

USGS – U.S. Geological Survey

WaSSI – Water Supply Stress Index Ecosystem Services Model

WATER – Water Analysis Tool for Energy Resources

WEPS – Wind Erosion Prediction System

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