

## Orientation to 2023 Billion-Ton Report Carbon Resource Classes and Constraints

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The 2023 Billion-Ton Report does not report total biomass resources. Rather, biomass resources in the BT23 are presented as production capacity within specified environmental constraints, at specified prices, and under specified market scenarios. (See BT23: U.S. Department of Energy (2024) Table ES-1, Figure ES-1, and Table 1.2 for orientation to these scenarios). Class-specific summary orientation and illustrated fractions of total biomass quantities above reported production capacity is provided:

- **Agricultural residues** (e.g. corn stover, wheat straw): estimates are not total in-field quantities, but rather are constrained for soil conservation (i.e., cannot exceed the tolerable soil loss limit as recommended by the USDA's Natural Resources Conservation Service, and cannot result in long-term loss of soil organic matter as estimated by the Revised Universal Soil Loss Equation and the Wind Erosion Prediction System). See U.S. Department of Energy (2024) table 1.4 and section 5.2 "Methods Summary", USDOE (2016) section 4.2.3 "Agricultural Residue Modeling Assumptions", and USDOE (2011) section 4.3. "Sustainability of Crop Residue Removal". Modeling results of agricultural residue production vary by county, but nationally result in about one-third of total residues being reported in the production capacity at the reference price of up to \$70 per dry ton at farmgate in the 2023 Billion-Ton Report (Figure 1).

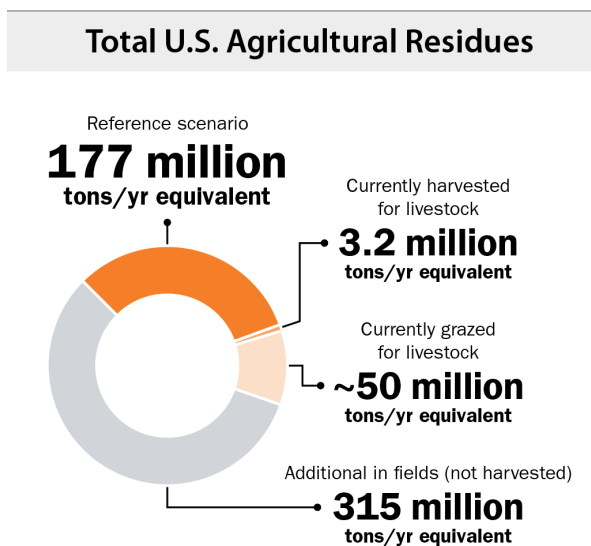


Figure 1. Estimated national corn stover and wheat straw supplies and fraction reported in 2023 Billion-Ton Report production capacity (Mature-Market Medium reference scenario). Source: U.S. Department of Energy (2024).

- **Timberland biomass resources** (e.g. logging residues and small-diameter trees): estimates are not total in-woods quantities, but rather are estimated with inclusion of environmental constraints. E.g., sensitive lands and wetlands are excluded, and harvests are limited to areas meeting the USDA Forest Service definition of timberland, where growth exceeds 20 cubic feet per acre per year of industrial wood; logging residues cannot exceed 70% and is limited further on slopes >40%; total harvests are constrained to not exceed net growth. See U.S. Department of Energy (2024) Table 1.5 and Chapter 4 "Biomass from the Forested Land Base", and USDOE

(2016) Chapter 3 “At the Roadside: Forest Resources”. Modeling results of timberland biomass resource production capacity vary by county, but nationally result in about 45% of total logging residues and less than 1% of timberland growing stock being reported in the Mature-Market Medium reference scenario production capacity at the reference price of up to \$70 per dry ton at roadside in the 2023 Billion-Ton Report (Figure 2).

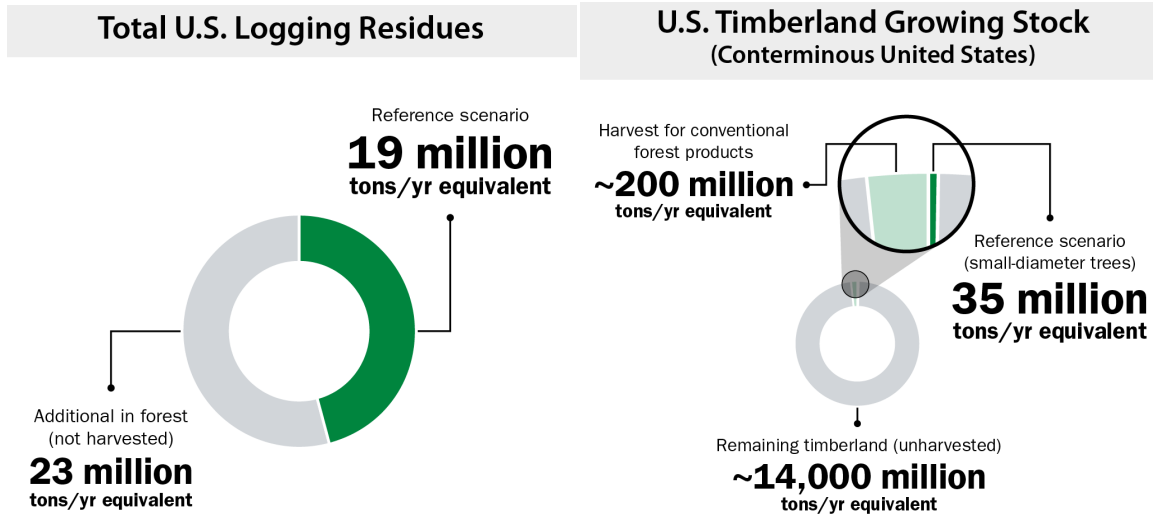


Figure 2. Estimated national timberland resources and fractions reported in 2023 Billion-Ton Report production capacity (Mature-Market Medium reference scenario). Source: U.S. Department of Energy (2024).

- Energy crops** (e.g. switchgrass, miscanthus, willow, poplar): Energy crops are not currently available at scale, but are estimated as production capacity in the future under mature-market conditions where. Estimates are derived from modeling based on current agricultural land uses, projected conventional crop demands, yields, production costs, and other factors. See U.S. Department of Energy (2024) chapter 5 “Biomass from Agriculture”, USDOE (2016) Chapter 4 “At the Farmgate”, and USDOE (2011) Chapter 5 “Biomass Energy Crops”. Mature-Market Medium results producing about 398 million tons per year of cellulosic energy crops occupy about 10% of agricultural land while meeting projected future conventional crop demands and leaving about 10% of agricultural land idle (Figure 3). Intermediate oilseeds are modeled between crop rotations and thus do not displace other cropland uses.

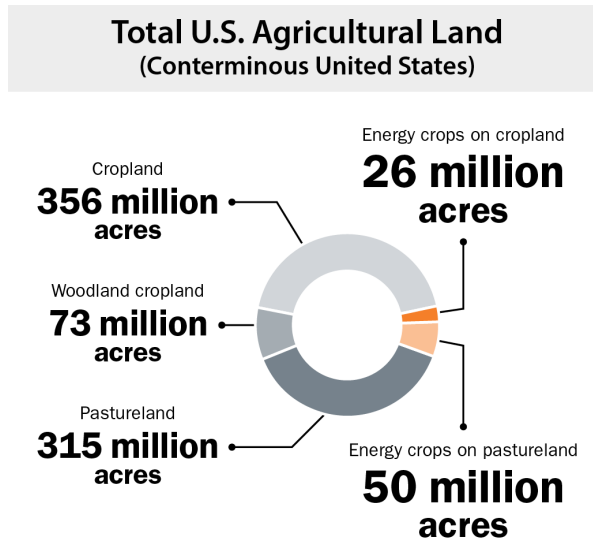


Figure 3. U.S. agricultural lands and fractions reported in 2023 Billion-Ton Report to produce energy crops in the Mature-Market Medium reference scenario. Source: U.S. Department of Energy (2024).

- Waste resources** (e.g. MSW, paper, plastic): County-level values provided in the BT23 are total waste production and are not reduced to account for recycling and current uses and thus may not be entirely available. National waste estimates (e.g. 217 million tons per year in the Mature-Market Medium Scenario) do account for recycling and current uses. Users can estimate fractions of waste availability after current uses from U.S. Department of Energy (2024) Table 3.1.
- Emerging resources** (microalgae, macroalgae, and CO<sub>2</sub>): Microalgae and macroalgae resources are not yet in production at scale. They are potentially available in the future at higher prices, but could see cost reductions with technological innovations. Point-source waste CO<sub>2</sub> resources exist today but will also need technological innovations for commercialization. See BT23 Chapter 7 for more information.

## References

- U.S. Department of Energy. 2024. 2023 Billion-Ton Report: An Assessment of U.S. Renewable Carbon Resources. ed. M. Langholtz. Oak Ridge, TN: Oak Ridge National Laboratory.
- USDOE. 2011. U.S. Billion-Ton Update: Biomass Supply for a Bioenergy and Bioproducts Industry. 1-227. Oak Ridge, TN: Oak Ridge National Laboratory.
- . 2016. 2016 Billion-Ton Report: Advancing Domestic Resources for a Thriving Bioeconomy, Volume 1: Economic Availability of Feedstocks. eds. M. Langholtz, B. Stokes & L. Eaton, 448. Oak Ridge, TN: Oak Ridge National Laboratory.