## GPRA Representation of the Biomass Program

The Biomass Program is comprised of four major elements: bio-products, bio-power, black liquor gasification, and cellulosic ethanol. The methodology for computing the GPRA benefits estimates varied depending on the type of program and the relevant components of the NEMS-GPRA04 framework.

The bio-products component seeks to develop biomass based chemical products through innovative refining processes. The use of biomass would displace the traditional reliance on petroleum and natural gas as chemical feedstocks. Because of the multitude of products and the complexity of the chemicals industry, the NEMS-GPRA04 does not have sufficient detail within its representation of this industry to explicitly model bio-products. Energy savings were estimated off-line based on a simplified market penetration approach (Fisher Pry curves) by the program office. These results were then modified to reflect an assumption of 15 percent per year from 2010. This more conservative approach was used, because EERE does not yet have a market-based model of bioproducts growth. The energy savings by fuel are subtracted from industrial energy consumption projected by NEMS-GPRA04. The model is then used to compute the other GPRA benefits metrics of primary energy savings, carbon emission reductions, and energy expenditure savings.

The main thrust of the bio-power program is to develop and verify gasification technologies which enable the increased efficiency of bio-power generation from the current 20 percent efficiency to 30-35 percent efficiency. In estimating the GPRA benefits, the biomass generation capital and O&M costs were modified to reflect the program's goals, as reflected in the EERE/EPRI Technology Characteristics report. These costs and the biomass heat rates were very similar to those already in the Baseline, although the projected increase in biomass capacity is quite small in the Baseline. In addition to competing on an economic basis with other electricity generation technologies, biomass capacity may be constructed for its environmental benefits. The PERI Green Power Market Model was used to estimate the potential demand for renewable generation, including biomass, in response to the expanding green power markets in many places across the country. The projections for green power biomass installations were incorporated into NEMS-GPRA04 as the planned capacity additions. The majority of projected biomass generating capacity for GPRA stems from the green power additions.

Black liquor and hog fuel gasification systems use waste fuels produced by the pulp and paper industry. The goal of the program is to replace relatively inefficient existing boilers and cogeneration systems with a more efficient gasification process. The increased steam and electricity output from the same waste fuel input will displace fossil fueled steam and generation. The program office provided penetration rates for black liquor gasification based on a recently updated analysis of age-related boiler rebuilding and replacement rates, and an estimate of market share for BLGCC. As a percent of total stock (which takes into account both replacement rates and BLGCC market share), the BLGCC is projected to reach 0.3 percent in 2010, 23 percent in 2020 and 84 percent by 2035 of black liquor use. The BLGCC market share was applied to new stock as well in the assumption that the new black liquor production would likely be from expansions of existing mills. These estimates for the penetration rate of black liquor gasification (BLGG) and the technology efficiency were used to modify the biomass cogeneration efficiencies over time, because NEMS-GPRA04 does not perform an economic competition for the black liquor technologies. The primary energy savings result from reduced fossil fuel consumption for steam production and for reduced demand for electricity purchased from the grid.

Cellulosic ethanol program is aimed at reducing the cost of producing ethanol from biomass other than corn, which is the current feedstock. The cellulosic ethanol production costs are assumed to improve in the Baseline to a similar degree as expected to be achieved with the program funding, but the growth in projected production is assumed to be constrained. For the GPRA benefits estimates, these constraints are relaxed, so that cellulosic ethanol production equals the program goals (assuming other Baseline

assumptions), which were developed using EERE's ethanol analytic model. NEMS-GPRA04 then adjusts the overall level of ethanol purchased by accounting for the price impacts of competing sources of demand for biomass (e.g., gasification to produce electricity). Petroleum and fossil energy savings occur when the cellulosic ethanol displaces gasoline through enhanced blending. For these GPRA projections, a large portion of the cellulosic ethanol displaced corn ethanol which does not lead to energy savings. The cellulosic ethanol does lead to additional carbon emission savings through an off-line adjustment that takes into account for its lower life-cycle carbon emissions that is not incorporated in NEMS-GPRA04.

| FY04 GPRA Benefits Estimates for Biomass (NEMS-GPRA04) | | | |
|---|---|---|---|
| | **2005** | **2010** | **2020** |
| Capacity (GW) | 0.0 | 0.2 | 0.5 |
| Generation (GWh) | 0.3 | 1.3 | 3.7 |
| Cellulosic Ethanol Production (Bil. gallons) | 0.00 | 0.70 | 2.70 |
| Energy Savings (quads) | 0.05 | 0.11 | 0.45 |
| Oil Savings (quads) | 0.01 | 0.05 | 0.22 |
| Carbon Savings (MMT) | 0.7 | 2.0 | 9.7 |
| Energy Expenditure Savings (B2000$) | 0.0 | 0.4 | 3.2 |