Summary of socioeconomic scenario descriptions – for permanent use or for use until RPA scenarios GTR is published (currently being updated in response to peer review)

For the 2020 RPA Assessment, the USDA Forest Service has adopted the scenario approach used by the Intergovernmental Panel on Climate Change (IPCC) in the IPCC Fifth Assessment Report (AR5) (IPCC 2014). Five shared socioeconomic pathways (SSPs) were developed in parallel to four Representation Concentration Pathways (RCPs) to provide scenarios of plausible alternative pathways of societal development and climate, respectively. These scenarios are not intended to "predict" the future, but are instead constructed to provide means of qualitatively and quantitatively understanding a plausible range of future climate and socioeconomic conditions. The combination of the IPCC-based emission and socioeconomic scenarios was chosen as the basis for the 2020 RPA Assessment because they provide quantitative data on both climate and socioeconomic variables over the needed time horizon, are well documented in the scientific literature, and are more current than other sources. For this work, as a precursor to the 2020 RPA Assessment, we downscaled global socioeconomic scenario projections to the national scale and subnational scale. The downscaled socioeconomic scenarios will be integrated with the biophysical scenarios to develop the context for evaluating resource futures in the 2020 RPA Assessment.

The five SSPs are comprised of storylines that include both quantitative data on population and economic trends and qualitative descriptions of other societal factors such as technology and governance. They were organized around challenges to mitigate or adapt to climate change. Four of the SSPs describe the range of high and low challenges for global adaptation and mitigation, while a fifth SSP defines an intermediate case. The SSPs do not include climate feedbacks or policy options (O'Neill et al. 2014).

Table 1 describes the SSPs across a selected set of characteristics that can be either quantitative or qualitative. The characterization of change is relative both to current global conditions and to global change among the SSPs. Each SSP has a narrative and a set of associated characteristics that make the pathway distinct from the others, although there

can be considerable variability amongst global regions within a particular SSP. The trend for each scenario characteristic shown in table 1 is the general global trend, except for the two elements that explicitly provide U.S. trends. For example, although global population growth is the lowest under SSP5, population growth in the United States is highest under this SSP. Similarly, economic growth under SSP1 is higher in low income countries than in high income countries (see O'Neill et al. 2017 for more detailed SSP descriptions).

**Table 1**. Selected characteristics of SSPs. Global trends provided unless U.S. trend is specified.

| SSP Element | SSP1 | SSP2 | SSP3 | SSP4 | SSP5 |
|---|---|---|---|---|---|
| Population growth | Low | Medium | High | Medium-high | Low |
| Migration | Medium | Medium | Low | Medium | High |
| Urbanization | High | Medium | Low | Medium-high | High |
| Per capita economic growth | Medium-high | Medium | Low | Low-medium | High |
| International trade | Moderate | Moderate | Strongly constrained | Moderate | High |
| Globalization | Connected markets | Semi-open globalized economy | De-globalizing | Limited global connections | Strongly globalized |
| Technology development | Rapid | Medium, uneven | Slow | Slow to rapid by sector | Rapid |
| Energy technology | Emphasis on efficiency and renewables | Continued reliance on fossil fuels | Slow change, directed to domestic energy | Diversified, with efficiency and low-carbon | Directed toward fossil fuels |
| Carbon intensity | Low | Medium | Depends on domestic sources | Low/medium | High |
| Energy intensity | Low | Uneven | High | Low/medium | High |
| U.S. population growth | Medium | Medium | Low | Low/medium | High |
| U.S. real GDP growth | Medium | Medium | Low | Medium | High |

Source: based on O'Neill et al. 2017.

To develop national socioeconomic scenarios linked to the global SSPs, we focused on the SSP variation in demographic and economic characteristics, which have been quantified at the country level (data available on the SSP public database at https://tntcat.iiasa.ac.at/SspDb/dsd?Action=htmlpage&page=welcome).

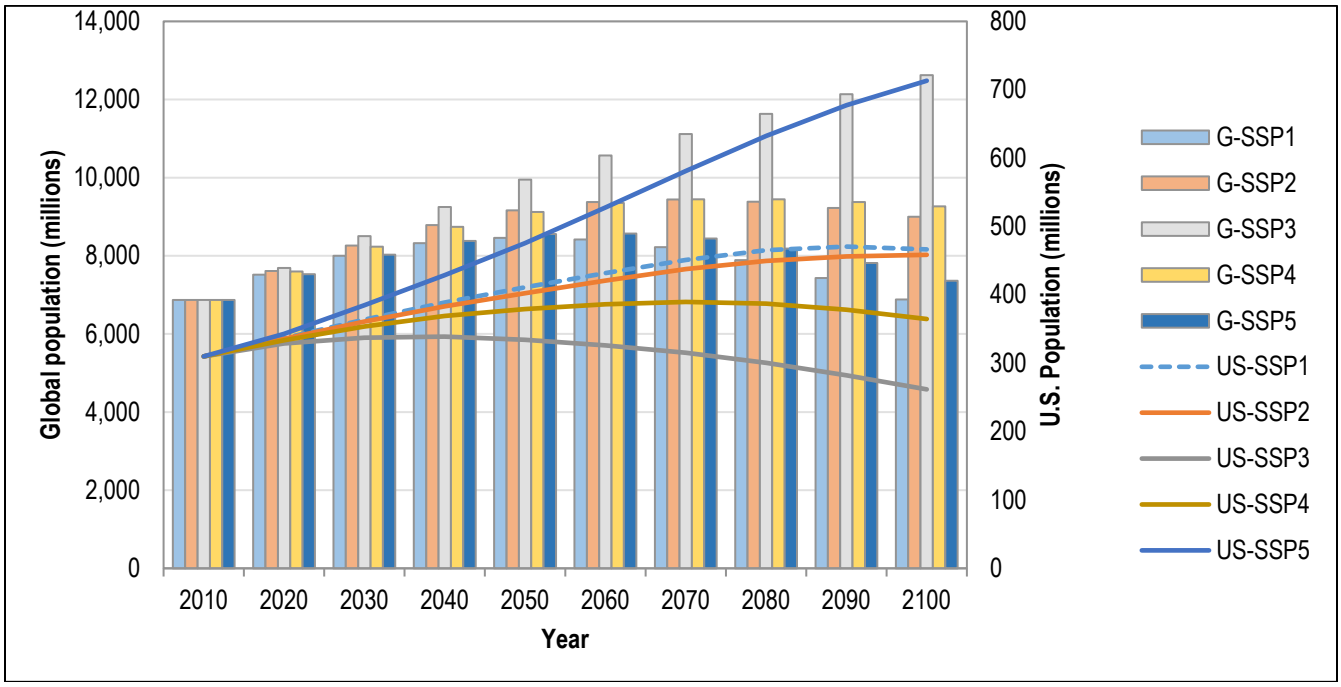
The country level projections of both population and income consistent with SSP global narratives were undertaken by three modeling groups. While the projections of population were quite consistent across all three groups, there were variations in projections of gross domestic product (GDP). We relied upon the economic projections provided by the International Institute of Applied Systems Analyses (IIASA) because they included more

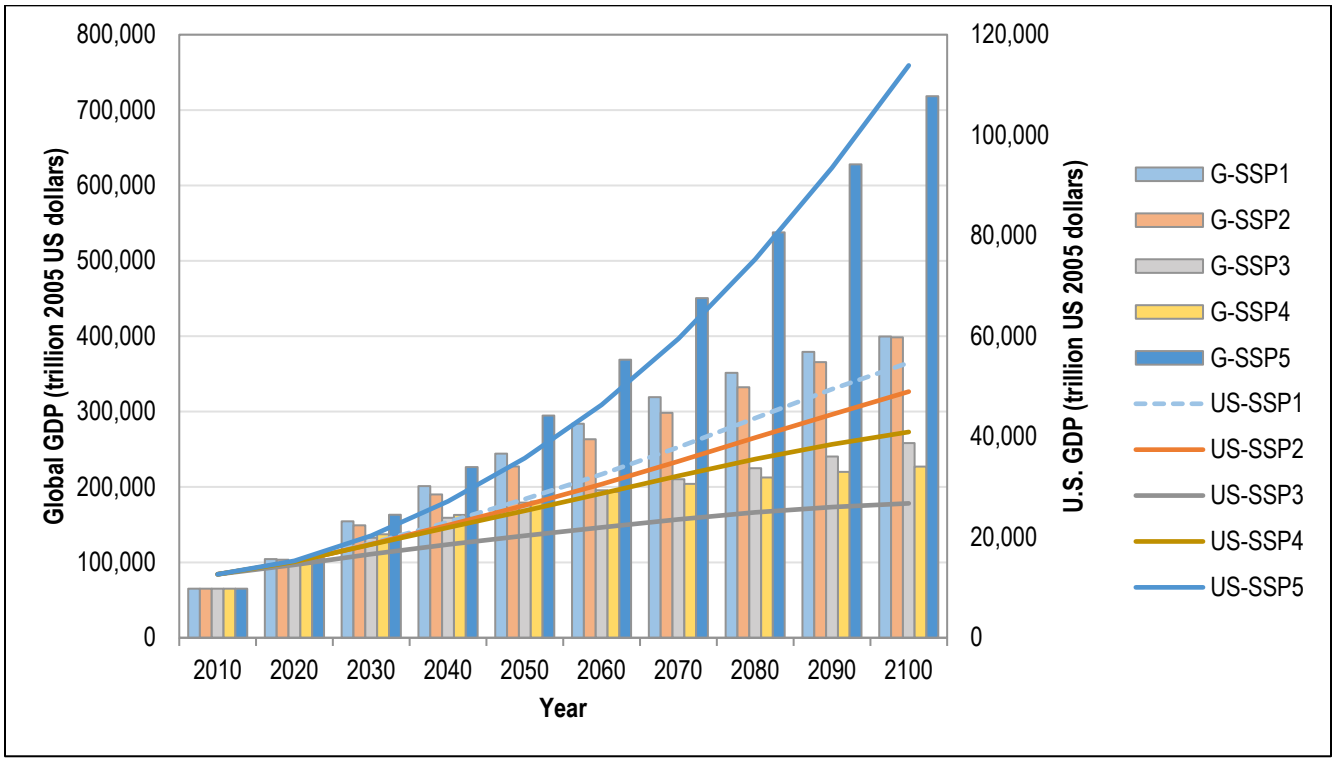
country-level projections that are important for modeling international trade flows as applied in RPA modeling of global wood products markets. The IIASA modeling methodology is described in Cuaresma (2017).

Figure 1 compares global and U.S. population projections and global and U.S. GDP projections for the five SSPs. While the SSP data are projected through 2100 to be consistent with the IPCC climate change projections, the 2020 RPA Assessment will focus on the time period 2020 to 2070. As seen in figure 1, divergence across the SSPs tends to accelerate to the end of the century.

Global and U.S. trends do not necessarily follow the same trajectory across SSPs. As seen in figure 1, global population trends and U.S. population trends diverge, with the highest population growth scenario for the United States having very little population growth globally (SSP5). Trends in GDP growth are more consistent between U.S. and global trends, although the lowest economic growth SSP for the United States is SSP3, while globally it is SSP4. In SSP1, world population begins declining after 2050, while U.S. population continues to grow until about 2090 and then flattens. U.S. trends for SSP2 are almost identical to SSP1, whereas globally the two SSPs diverge markedly in population, but are quite similar in GDP trends. SSP3 and SSP5 bracket the high and low changes in population and GDP for the United States, with the highest population growth associated with the highest economic growth (SSP5), and the lowest economic growth associated with a declining population (SSP3). These patterns are tied to a number of interacting assumptions about economic growth, fertility and mortality, migration patterns, and the openness of the global economy.

**Figure 1**. Global and U.S. population projections (top) and global and U.S. GDP projections (bottom) by Shared Socioeconomic Pathway (SSP), 2010-2100.




Source: Based on the SSP database hosted by the IIASA Energy Program at https://tntcat.iiasa.ac.at/SspDb.

While we developed county level downscaled data for all five SSPs, only four socioeconomic scenarios were selected for use in the RPA Assessment. We selected SSP3 and SSP5 because they bound the demographic and economic change for the United States and capture most of the range in global change as well. SSP4 has a lower growth in global GDP than SSP3, but the difference is relatively small compared to variation across the other SSPs. SSP1 and SSP2 follow similar trajectories for the United States and globally, however the underlying narrative for these pathways offers opportunities to explore differences among resource and sector specific variables that potentially will have different natural resource effects. For example, the narrative for SSP1 is more focused on low emission energy sources, while SSP2 is more tightly linked to historical patterns of energy use. Therefore, we decided to retain both SSP1 and SSP2. We eliminated SSP4 because its trajectory falls between SSP3 and SSP2, leaving SSP1, SSP2, SSP3, and SSP5 as we moved to the final stage of determining the combination of RCPs and SSPs for the RPA Assessment.

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