

BIOMASS RESIDUE PRODUCTION AND END-USAGE

Bioenergy assumes crucial importance in terms of energy security, environment and economy. The components that presently make up bioenergy production in India are agricultural residue, forest residue, sugarcane molasses-based bioethanol, Jatropha biodiesel and biogas. 95% of the present bioenergy production relates to agriculture residue and forestry residue (177 and 137 million tons (dry)). Bioenergy production is already estimated to be about 1842 TWhr/year (25% of the total energy consumption of India. The biomass residues are mainly used for cooking. Part of agri-residue (about 15 million tons) is used for power generation (2.5 GW). The agri-residue that accounts for bioenergy is 67% of the residue that is not used as animal fodder (287 million tons (dry)). This split is maintained in future for all the four levels, leaving the other 33% constant for other uses. The agri-residue productivity is projected to increase from 0 to 1% (annual) across the four levels. As for forestry residue, 160-180 million tons/year (dry) is rated to be the sustainable limit for recovery from forests and it is extended across the four levels accordingly.

Presently most of the agri-residue used for bioenergy is used as solid fuel for cooking (62% out of 67%). The remaining fraction is used for power generation (5% out of 67%). The forestry residue is entirely used for cooking. The biomass residue used for cooking is used inefficiently in traditional cookstoves. Improved-efficiency cookstoves are expected to be used in future. The proportion of agri-residue is projected to increase for power generation applications in future (10-30% out of 67% across the four levels). Agri-residue is also expected to be converted to liquid transportation fuels in future (4-30% out of 67% across the four levels) as the conversion technologies mature. Transportation fuels have a critical implication on the nation's economy given the huge strain placed by the crude oil import bill (6,000 billion rupees). The split that is used for cooking as solid fuel is projected to decrease from the present 62% (out of 67%) to 53-11% across the four levels. The forestry biomass is modeled to be used only for cooking as solid fuel across all the four levels

Level 1

The annual agri-residue productivity is maintained at the same level of present productivity without any increase. The forestry residue for cooking is already believed to be close to saturation and is projected to increase only to 144 million tons (dry)/year from 137 million tons (dry)/year. The split of non-fodder agri-residue for power generation is increased

from the present 5% to 10%. The energy conversion plant efficiency is kept the same as the present efficiency (25%). This relates to power generation increasing from the present 2.5 GW to 5 GW by 2047. Liquid transportation fuel from agri-residue begins to be produced commercially from 2027 and the split reaches 4% by 2047. This leaves the agri-residue split for cooking (solid fuel) decrease from 62% in 2012 to 53% in 2047.

Level 2

0.25% annual growth rate is considered for the agri-residue productivity. The forestry residue is projected to increase to 158 million tons (dry)/year. The split of non-fodder agri-residue for power generation is increased from the present 5% to 18%. The plant efficiency is projected to increase from 25% to 35%. This results in power generation increasing from the present 2.5 GW to 13.5 GW by 2047. Liquid transportation fuel from agri-residue begins to be produced commercially from 2022 and the split reaches 8% by 2047. This leaves the agri-residue split for cooking (solid fuel) decrease from 62% in 2012 to 41% in 2047.

Level 3

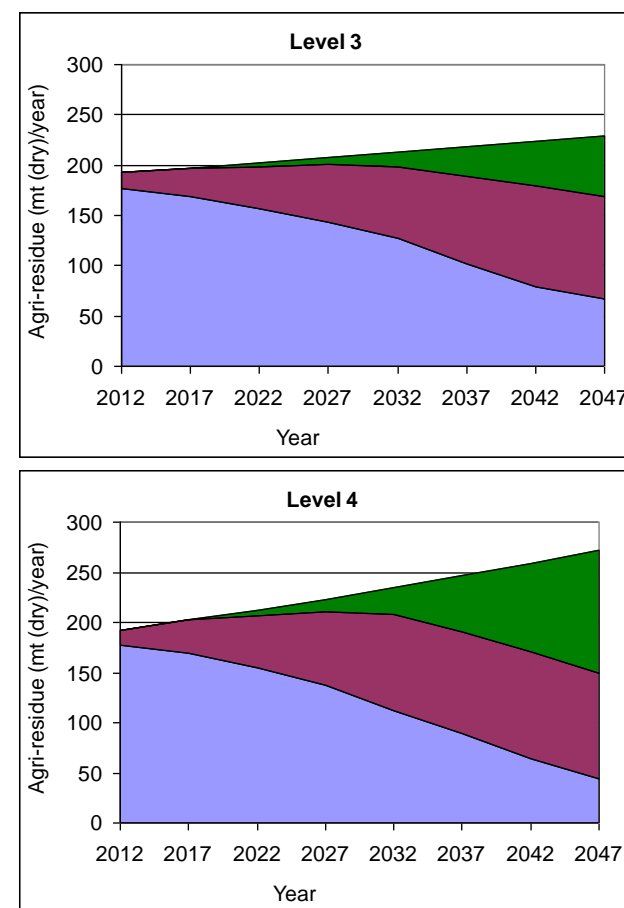
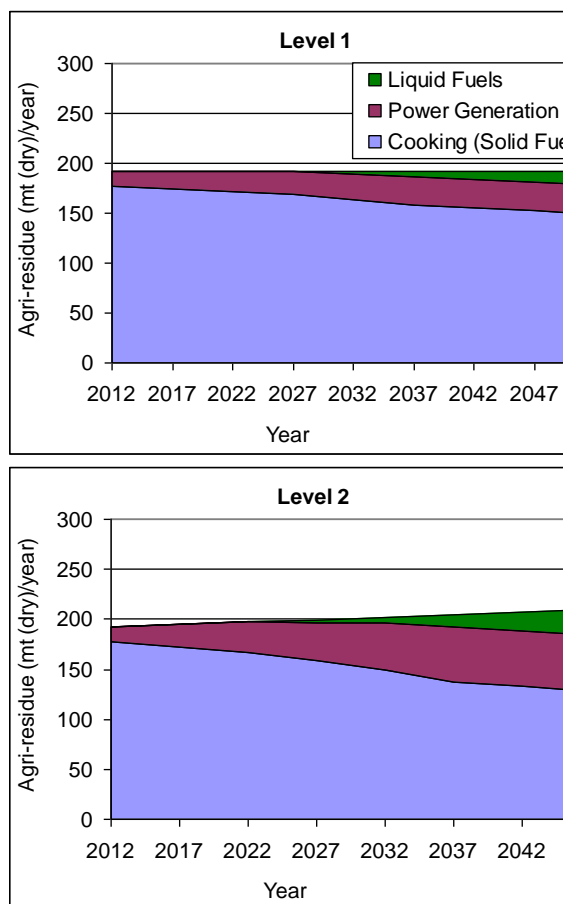
The agri-residue productivity is projected to increase at an annual growth rate of 0.5%. The forestry residue is projected to increase to 171 million tons (dry)/year. The split of non-fodder agri-residue for power generation is increased

from the present 5% to 30%. The plant efficiency is projected to increase from 25% to 42%. This relates to power generation increasing from the present 2.5 GW to 29 GW by 2047. Liquid transportation fuel from agri-residue begins to be produced commercially from 2020 and the split reaches 18% by 2047. This leaves the agri-residue split for cooking (solid fuel) decrease from 62% in 2012 to 19% in 2047.

Level 4

The agri-residue productivity is projected to increase at an annual growth rate of 1%. The forestry residue is projected to increase to 180 million tons (dry)/year. The split of non-fodder agri-residue for power generation begins to increase from the present 5%, reaches a maxima of 28% by 2037 and then decreases to 24% by 2047 as the conversion to liquid fuels become more pronounced. Liquid transportation fuel from agri-residue begins to be produced commercially from 2017 and the split increases to 30% by 2047. This leaves the agri-residue split for cooking (solid fuel) decrease from 62% in 2012 to 11% in 2047.

Biomass Residue and End-Usage



Projection of Agri-Residue and End-Usage