Competition biomass energy vs. food

An adult human being is a 120 W machine. Suppose we get our energy 80% from vegetables (= 'direct' biomass) and 20% from meat (= 'indirect' biomass), assuming an 'efficiency' from primary biomass-to-meat of 10%.

- How much MJ/day, and kWh/yr, does 1 adult need in food from primary biomass?
- How much primary biomass does the world population consume? (8.2 billion people) Assume that average consumption is about half of the 'standard adult' (to account for children, elderly, less meat diet etc. …).
- Assess the result in view of the biomass energy potential and agricultural production.

Estimate of residual biomass as resource, primary and final energy

Assumptions:

a) Agriculture: from agricultural production (152 EJ/yr), discount the energy requirement to feed humans (=preceding exercise). Assume that from the remainder, most is used to feed animals, some is composted, and 10% can counts as 'residual' energy from agro-waste.

b) Forestry: assume 2 kg/m^2 dry wood growth per year (LHV: 17 MJ/kg); assume 2% of the world's forest area is trimmed (from where this waste wood can be recovered as 'residual' energy)

c) Animal manure: assume a production of 1 m^3 of biogas per day (with 50% CH_4 content) per large farm animal and that there are half as many large farm animal-'equivalents' as people. (LHV of CH_4 = 36 MJ/m^3 = 10 kWh/m^3)

d) Solid organic wastes from human activities (food waste, parks and garden wastes, food industry,..): assume a waste of 1 kg dry organic matter per week per person, converted to 500 L biogas per dry kg, with a CH_4 content of 60%

e) Human liquid organic waste (sewage → waste water treatment plants): assume a production of 30 L biogas per day per person, with a CH_4 content of 65%.

From all this data, compute the total residual biomass primary energy potential and how this relates to the total human primary energy consumption/yr.

For the conversion to final energy, make realistic choices for the conversion technology (for power), and the corresponding conversion efficiencies.