

## ***Biomass and Bioenergy***

### **SUBJECT CLASSIFICATION – (with typical associated keywords in parentheses)**

#### **1. Biomass**

- a. Sources (Forest, Agriculture, wastes, residues, aquatic, field, animal, oil seeds, firewood)
- b. Energy crop production processes
  - i. Short rotation coppice (SRF, Poplar)
  - ii. Energy Grasses (herbaceous crops, switchgrass, miscanthus)
  - iii. Other energy crops (Jatropha, Algae)
- c. Genetic improvements (selection, DNA, sequencing, biotechnology)
- d. Composition (elemental, proximate, ultimate, compositional, heating value)

#### **2. Biological Residues**

- a. Residue and Wastes from agricultural production and forestry
  - i. Collection, harvesting & delivery systems (logistics)
  - ii. Storage and drying
- b. Processing industries (co products, by products, bagasse, sawdust)
- c. Municipal sources (paper, construction and demolition)

#### **3. Bioenergy Conversion Processes**

- a. Pretreatment (steam, torrefaction, pelletizing, densification)
- b. Fermentation (aerobic, anaerobic)
- c. SSF (enzymes, cellulase,)
- d. Anaerobic digestion (UASB, two stage, acidification)
- e. Thermochemical conversion
- f. Combustion (small scale, heating, cooking, travelling grate, CFB)
- g. Gasification (downdraft, fixed bed, BFB, CFB, SNG, gas cleaning, reforming)
- h. Pyrolysis (fast, slow, pyrolysis oil, char, biochar, charcoal, retort)
- i. Liquefaction (hydrothermal, indirect {see biofuels})

#### **4. Bioenergy utilisation**

- a. Direct combustion (steam cycle, hot oil, kiln, furnace)
  - i. Co-firing (coal, natural gas)
  - ii. CHP
- b. Gasification (kilns, syngas, producer gas)
- c. Electricity Production (fuel cell, gas turbine, steam, carnot cycle, brayton cycle, Stirling)
- d. Chemicals (platform chemicals, intermediates, polymers)
- e. Biofuels
  - i. Biodiesel (Fatty acid methyl ether (FAME), FAEE, Engines)
  - ii. Bioethanol (1<sup>st</sup> generation, 2<sup>nd</sup> generation, distillation, fermentation)
  - iii. Biobutanol (fermentation, Clostridia)
  - iv. Biomethanol (syngas, catalyst)
  - v. Pyrolysis oil
- f. Petrochemical substitutes (Fischer Tropsch, synthetic natural gas, BioSNG)
- g. By-product remediation

## **5. Biomass , Environment & Economics**

- a. Land availability
  - i. Systems studies (equilibrium models, input-output)
  - ii. GIS (remote sensing)
  - iii. Landuse modelling for bioenergy
- b. Systems analysis (climate change,
- c. Carbon cycle (soils, atmosphere, Greenhouse gas (GHG))
- d. Net energy efficiency of bioenergy Systems
- e. Life cycle assessment (LCA) of bioenergy systems (ISO 14040, impacts, allocation)
- f. Assessment of sustainability
- g. Biodiversity (birds, arthropods, mammals, flora)
- h. Technoeconomics of bioenergy systems (rate of return, financial analysis)
- i. Socio-economic issues (employment, income, equity)