Radiation technology, using gamma or electron beams, develops its benefits at highest yield if macromolecular systems are treated. This is valid equally if build-up processes (polymerization, crosslinking) or degradative processes (chain scission, depolymerization) are initiated by radiation.

Radiation-induced degradation is used to convert polytetrafluoroethylene (Teflon) scrap into powder and low-molecular-weight products used in the production of other perfluoro compounds. Irradiation with several hundred kilograys in the presence of additives gives a fine powder of polytetrafluoroethylene. The powdered Teflon polymer has additional functional groups that are not present in the original polymer, e.g. carboxylic acid groups, if irradiation is carried out in the presence of oxygen or air. The pilot plants treating Teflon scrap use electron accelerators. The Teflon powder produced is blended with other materials for use as a lubricant, and the perfluorocarboxylic acids are employed as surfactants.

Radiation-induced chain scissions may find novel applications in converting natural polymers of biomass origin as well. EB treatment of wood and cellulose results in significant energy saving in wood pulping and in viscose (regenerated cellulose) production.

Radiation treatment of polymers could play an important role in the recycling of polymer wastes in case of natural and synthetic polymers as well. The non-selective energy transfer from gamma or electron sources to polymer systems produces many kind of reactive centers such as free radicals, oxider and peroxydized active groups, on which further reactions may occur. In presence of monomer-like or oligomer-like reactive additives graft-copolymerization may take place, compatibilizing on that way the originally incompatible polymer components. Such a compatibilization is the key solution of recycling commingled plastic waste.

Radiation processed common recycling of synthetic and natural waste materials may result in reinforced composite systems as well. New procedures have been developed to produce wood-fiber-reinforced plastic composites from thermoplastic matrices and cellulosic fibers in the presence of selected reactive additives, using electron-beam processing.