Oxidative decarboxylation is a biochemical process that involves the removal of a carboxyl group (COOH) from a molecule along with the release of carbon dioxide ($CO_2$) and the generation of high-energy electrons.

In cellular metabolism, oxidative decarboxylation reactions are commonly associated with the breakdown of organic compounds, such as carbohydrates, fats, and amino acids, to release energy. These reactions typically occur in specific metabolic pathways, such as glycolysis and the citric acid cycle.

During oxidative decarboxylation, a specific enzyme catalyzes the removal of the carboxyl group from a substrate molecule. This process is coupled with the transfer of electrons to an electron carrier molecule, such as nicotinamide adenine dinucleotide (NAD+) or flavin adenine dinucleotide (FAD), which are reduced in the process.

The release of carbon dioxide and the transfer of high-energy electrons to the electron carrier result in the production of reduced forms of these molecules, namely, NADH and $FADH_2$. These high-energy electron carriers play a crucial role in further energy production through oxidative phosphorylation, which occurs in the mitochondria.

Oxidative decarboxylation reactions are key steps in the overall energy-yielding metabolism of various biomolecules. For example:

In glycolysis, the breakdown of glucose is initiated by the enzyme hexokinase and proceeds through several steps, including oxidative decarboxylation reactions. One such reaction occurs during the conversion of glyceraldehyde-3-phosphate to 1,3-bisphosphoglycerate, with the generation of NADH and the release of $CO_2$.

In the citric acid cycle (also known as the TCA cycle or Krebs cycle), oxidative decarboxylation reactions play a significant role. For instance, during the conversion of isocitrate to alpha-ketoglutarate, the carboxyl group is removed as $CO_2$, and NADH is produced.

The high-energy electrons generated during oxidative decarboxylation reactions, carried by NADH and $FADH_2$, are later utilized in the electron transport chain, which leads to the production of adenosine triphosphate (ATP) through oxidative phosphorylation.

Overall, oxidative decarboxylation reactions play a critical role in cellular metabolism by facilitating the breakdown of organic molecules, releasing energy in the form of high-energy electrons, and providing substrates for further energy production.