Recent advances in radioactive-ion beams and ion-trapping techniques are opening up new opportunities for improved measurements of the particles emitted in nuclear beta decay. The Beta-decay Paul Trap (BPT) and a range of radiation-detection systems have been developed to perform precision beta-decay studies to address topics ranging from electroweak theory to the origin of the elements and to provide nuclear data for nuclear-energy and stockpile-stewardship applications. When a radioactive ion decays in a trap, the recoil-daughter nucleus and emitted particles emerge from the trap volume with negligible scattering and propagate unobstructed through vacuum. This allows the momentum and energy of particles that would otherwise be difficult (or even impossible) to detect to be reconstructed from the momentum imparted to the recoiling nucleus. A determination of the direction and energy of each emitted neutrino in the decays of $^8$Li and $^8$B has been performed to search for new particles and interactions. In addition, beta-delayed neutron spectroscopy can be performed by circumventing the difficulties associated with direct neutron detection and instead reconstructing the neutron emission probabilities and energy spectra from the time of flight of the recoiling nuclei. Recent results from decay studies using the BPT at Argonne National Laboratory will be presented and future prospects for these approaches as well as other precision beta-decay measurements will be discussed.