This paper provides a review of the hybrid (Monte Carlo/deterministic) radiation transport methods and codes developed at the Oak Ridge National Laboratory and examples of their application for increasing the efficiency of real-world, fixed-source Monte Carlo analyses. The two principal hybrid methods are: (1) Consistent Adjoint Driven Importance Sampling (CADIS) for optimization of a localized detector (tally) region, e.g., flux, dose, or reaction rate at a particular location and (2) Forward Weighted CADIS (FW-CADIS) for optimizing distributions (e.g., mesh tallies over all or part of the problem space) or multiple localized detector regions (e.g., simultaneous optimization of two or more localized tally regions). The methods provide consistent source and transport (weight windows) biasing parameters based on deterministic importance functions for optimizing Monte Carlo simulations. FW-CADIS is a recent extension of the CADIS method that has been used for more than a decade to dramatically improve the efficiency of Monte Carlo simulations for many source-detector type problems. The basis of the FW-CADIS method is the development of a function that represents the importance of particles to the objective of uniform Monte Carlo particle density in the desired tally regions. This method is significant in that it enables high fidelity Monte Carlo results for distributions (e.g., spatial dose distribution) in large phase-spaces, a capability typically only attributed to deterministic methods. The two methods have been implemented and automated in both the MAVRIC sequence of SCALE 6 and ADVANTG, a code that works with the MCNP code. As implemented, the methods utilize the results of approximate, fast-running 3-D deterministic transport calculations (with the Denovo code) to generate consistent space-and energy-dependent source and transport biasing parameters. These methods have been applied to many relevant and challenging problems, including dose rates throughout an entire PWR facility, arrays of commercial spent fuel storage casks, criticality accident alarm system analyses, special nuclear material detection scenarios, and nuclear well-logging simulations. Excellent results have been achieved in all applications to date. The full paper will provide a review of the methods, their implementation, results of their application to problems relevant to the conference scope, and current and planned future development activities.