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We prove the existence of efficient dominating sets for the infinite graphs obtained from the regular tessellations of the Euclidean plane. We then consider the analogous problem for a wider class of tessellations, first Archimedean tilings of the plane, then tessellations of  $d$ -dimensional space for  $d > 2$ . We also study other classes of infinite graphs that are highly symmetric and regular or "almost" regular, such as  $k$ -ary trees, the Sierpinski gasket graph, graphs obtained from hyperbolic tilings, graphs of nested polygons, and vertex-transitive planar graphs that are not tessellations, in terms of how efficient their dominating sets can be. We discuss the methods that unify our study of efficient domination on infinite graphs with additional structure that gives us a measure of how close to regular they are. These methods include the concept of the "growth rate of the boundary" of an infinite graph constructed iteratively, and the independence of domination fraction from which set of finite graphs is used to construct the infinite graph. (Received September 20, 2010)