Purpose: Proton therapy machines with lower beam energy requirements are expected to be easier and more cost-efficient to design, construct, and operate, particularly when using novel proton acceleration technology (e.g., dielectric wall). We determine, for adult central nervous system (CNS) and head and neck (HN) and pediatric cases, the optimal proton beam energies that can lead to clinically acceptable plan quality. Methods: Proton treatment plans for various adult CNS and HN and pediatric cases, previously treated at our institution using helical tomotherapy, were generated using a commercial planning system (XiO, v. 4.62, Elekta) with a passively-scattered proton beam model. Proton beam orientations were chosen such that the distance from the skin to the distal target edge was minimal; however, beams could not pass through areas with significant surface irregularity (e.g. ear), nor through OARs with strict dose limitations (e.g. lens). For a given beam direction, the planning system would calculate an optimum range and modulation to cover a given target volume. Beam weights were adjusted so that 95% of the target volume received the prescribed dose. All plans were limited to two proton beams. Results: An optimal proton energy exists for each case studied. Among all cases, target dose conformity (the ratio of target volume to volume encompassed by the prescribed dose) ranged from 0.74 to 0.94, and target dose uniformity (the ratio of the D5 and D95 doses) ranged from 1.01 to 1.04, with the optimal proton energies. Among the CNS and HN cases and for most pediatric cases, the maximum proton energy required was 133 MeV. For a pediatric abdomen case, 159 MeV protons were required. Conclusions: For proton treatment of most adult CNS and HN and pediatric cases, the optimal energies that are capable of generating good quality plans are only as high as 130 MeV.