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Parvalbumin-positive fast-spiking neurons of the neocortex are electrophysiologically specialized for the generation of rapid, sustained trains of action potentials. While the biophysical specializations permitting such fast spiking are well understood, the metabolic costs of these specializations have not been investigated. Here, we use a combination of in vitro electrophysiology, high-speed dynamic clamp, and computational modeling to investigate the tradeoffs between a neuron's ability to generate fast trains of action potentials and the energetic cost of these action potentials. We find substantial differences in the metabolic costs associated with various strategies for the generation of the fast-spiking phenotype. As the brain is among the body's most metabolically costly tissues, and action potential generation has been estimated to be among the most metabolically costly aspects of neuronal function, an understanding of the relative costs and benefits of these specializations is likely to lead to an improved understanding of the energetic and functional constraints on inhibitory circuit evolution and operation.

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