Energetic electrons of up to tens of MeV are created during explosive phenomena in the solar corona and in the Earth's magnetotail. While many theoretical models consider magnetic reconnection as a possible way of generating energetic electrons, the precise roles of magnetic reconnection during acceleration and heating of electrons still remain unclear. Here, we show from two-dimensional particle-in-cell simulations that coalescence of magnetic islands that naturally form as a consequence of tearing mode instability and associated magnetic reconnection leads to efficient energization of electrons. The key process is the secondary magnetic reconnection at the merging points, or the “anti-reconnection,” which is, in a sense, driven by the converging outflows from the initial magnetic reconnection regions. We also performed a simulation of a conventional, single X-line reconnection and show that a system with multiple reconnection sites or ‘X-lines’ along a thin current sheet indeed leads to a larger number of energetic particles (both ions and electrons) when compared to a single (or isolated) X-line case. In this talk, we discuss possible applications to the energetic electrons observed in the solar flares as well as the Earth's magnetotail.