Static and dynamic energetic disorder in emission layers of organic light-emitting diodes (OLEDs) is investigated through combined molecular dynamics and hybrid quantum mechanics/molecular mechanics (QM/MM) calculations. The analysis is based on a comparison of ensemble and time distributions of site energies of guest and host components in an emission layer. The law of total variance is applied to decompose the total disorder into its static and dynamic contributions. It is found that both contributions are of the same order of magnitude. While the dynamic disorder is not affected by intermolecular interactions, the static disorder for both guests and hosts is determined by the polarity of host molecules. The amount of static disorder affects charge-transport properties and exciton formation pathways, which consequently influence the overall efficiency of an OLED device. The simulations indicate that the amount of static disorder induced by the host should be considered for the optimization of the emission layer.