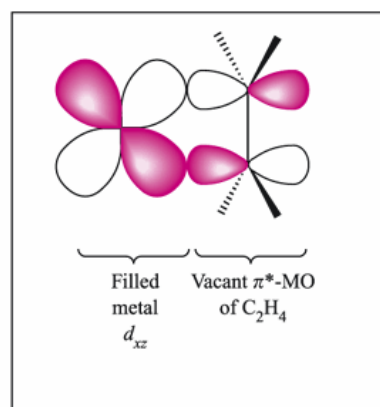
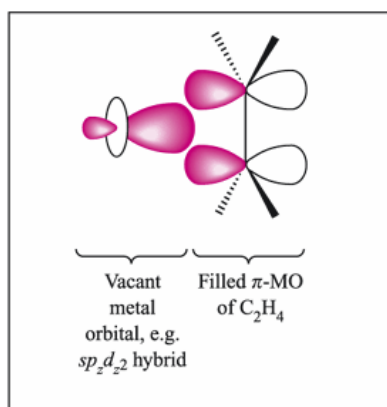
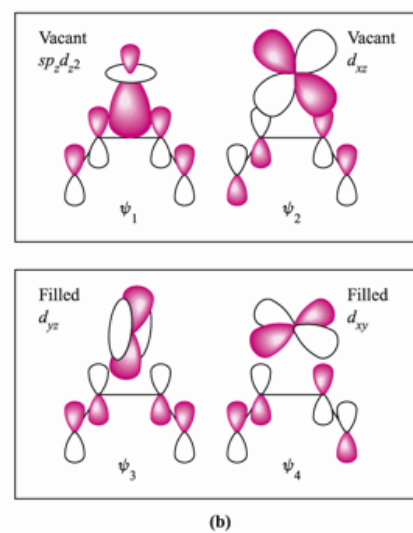
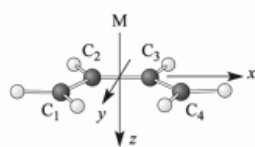
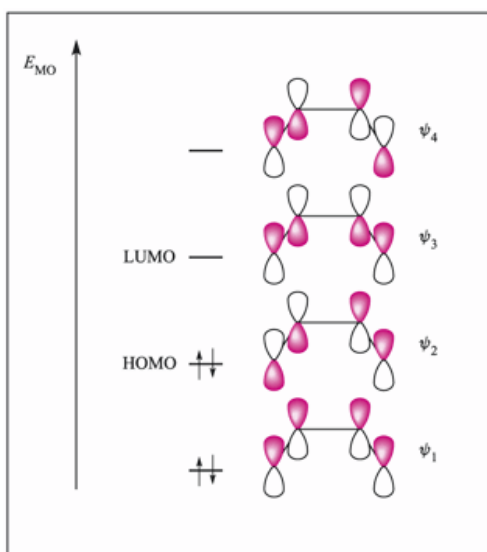


### Components of metal-dihydrogen bonding

(a) H<sub>2</sub>-to-M donation using the H<sub>2</sub>  $\sigma$ -bonding MO, and (b) back-donation into the H<sub>2</sub>  $\sigma^*$ -MO.



Components of **metal-alkene bonding**: (a) donation of electrons from the alkene  $\pi$ -MO to a suitable metal  $d$ -orbital, and (b) back donation of electrons from metal to alkene  $\pi^*$  MO.



(a) the four  $\pi$ -MOs of **buta-1,3-diene**; (b) the combinations of metal and ligand orbitals that lead to transfer of charge from diene to metal (top) and from metal to diene (lower diagram).