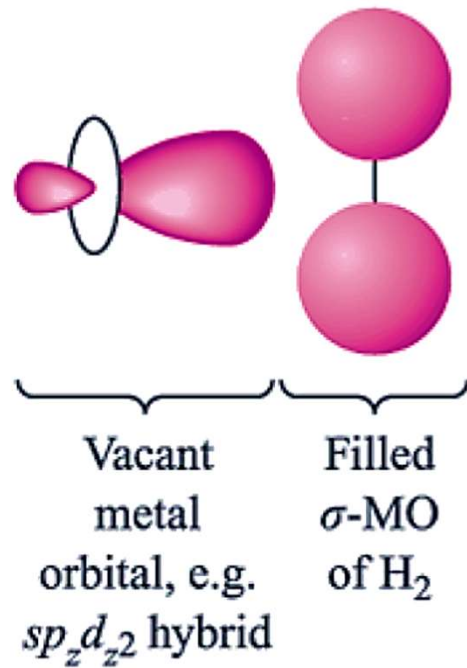
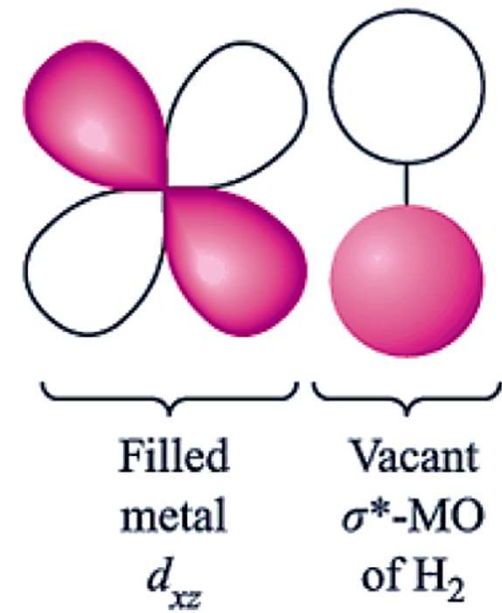
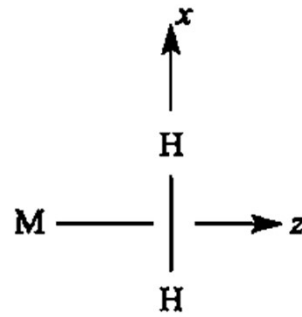


# Metal–dihydrogen bonding

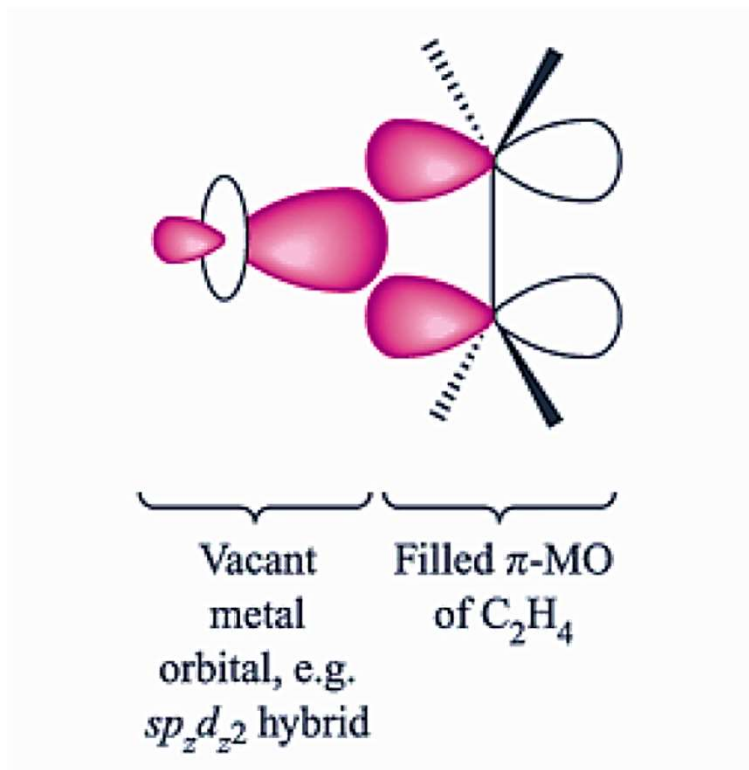


**H<sub>2</sub>→M donation**

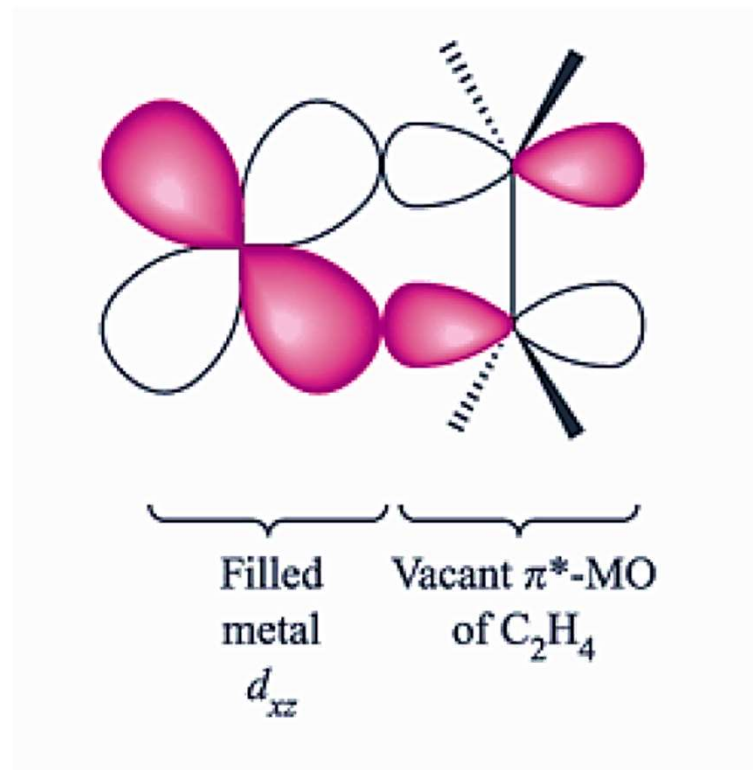


**M→H<sub>2</sub> back-donation**

# Metal–ethylene (alkene) bonding

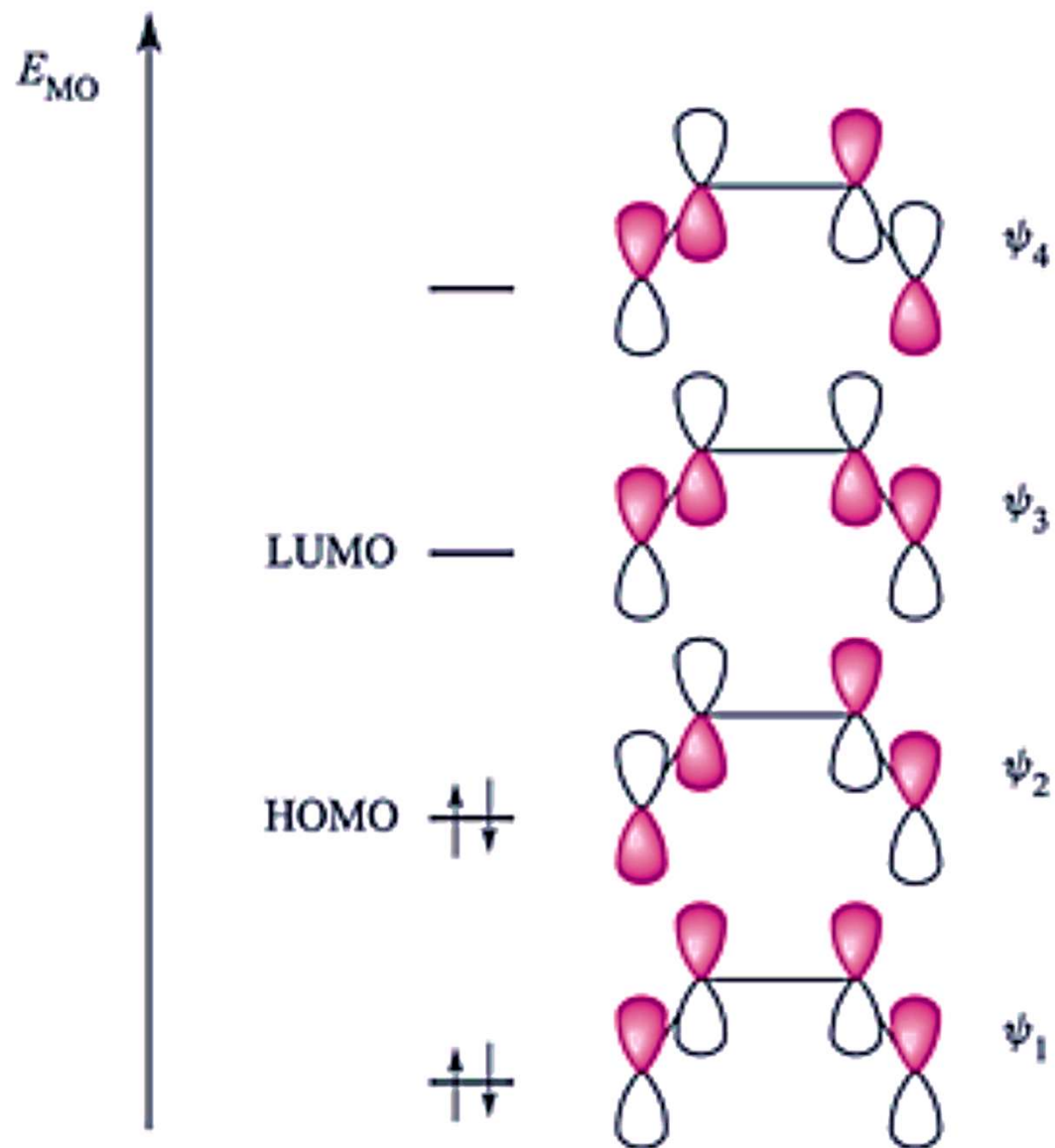


$C_2H_4 \rightarrow M$  donation



$M \rightarrow C_2H_4$  back-donation

# Metal-but-1,3-diene bonding



Molecular orbitals of buta-1,3-diene

# Metal–buta-1,3-diene bonding

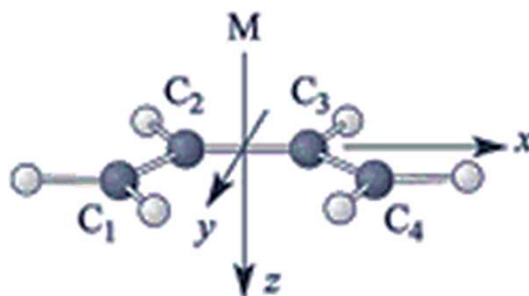
Vacant  
 $sp_z d_{z^2}$



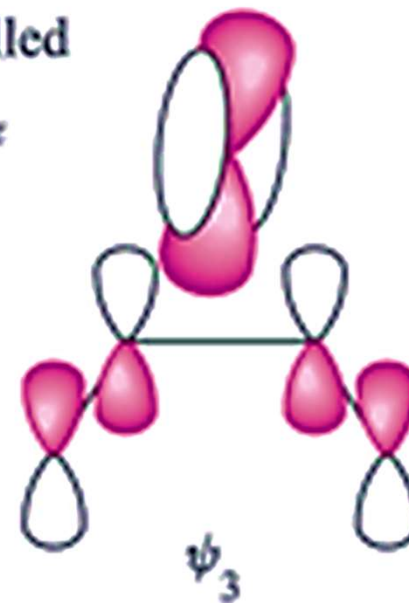
Vacant  
 $d_{xz}$



**Diene→M donation**



Filled  
 $d_{yz}$



Filled  
 $d_{xy}$



**M→diene back-donation**