A similar orbital treatment of 1,3,5-hexatriene yields delocalized orbitals as in the following diagram:

\[
\begin{align*}
  &\text{HOMO} \quad \chi_3 \quad 2 \quad \begin{array}{c}
  \text{nodes} \quad \chi_6^* \quad 5 \quad \chi_5^* \quad 4 \quad \chi_4^* \quad 3
  \\
  \text{LUMO} \quad \chi_1
  \\
  \end{array} \\
  \text{delocalized } \pi/\chi \text{ molecular orbitals of } 1,3,5\text{-hexatriene}
\end{align*}
\]

Once again the HOMO has nodal characteristics in agreement with the Lewis structure. As outlined in the next figure, 1,3,5-hexatriene can exist in $E$ or $Z$ configurational forms about the central double bond. The figure sketches the conformational analysis by which one can conclude that in each case the s-trans/s-trans conformation is most stable:
It is interesting to note qualitatively what happens to delocalized $\pi$ orbital energy levels as one moves from ethylene to longer and longer polyene chains. The final figure shows how the energy gap between the HOMO and the LUMO decreases. The consequence is that as one increases the number of connected
formal double bonds in the chain (increases the "conjugation"), less and less energy is required to make the transition to the first excited state. Whereas for ethylene and 1,3-butadiene this transition occurs only in the ultraviolet region of the spectrum, already with 1,3,5,7-octatetraene one has some absorption in the visible. The visual pigments of our eyes have structures that contain relatively long arrays of conjugated double bonds; for example, rhodopsin has six conjugated double bonds in its chromophore.

Increasing the conjugated polyene $\pi$ system length decreases the HOMO → LUMO energy gap

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