Carbon also is found in structures having a linear geometry, the prototype being the molecule ethyne, or as it still commonly is called, acetylene. Acetylene has the formula $\text{C}_2\text{H}_2$, with the atoms arranged as $\text{H—C—C—H}$. All four atoms lie along a linear axis. The $\text{C—C}$ bond length in acetylene is considerably shorter than in ethylene (1.20Å vs. 1.34Å). To rationalize the bonding we mix the 2s and 2p$_x$ orbitals of carbon to form two equivalent linear sp hybrid orbitals, leaving the 2p$_y$ and 2p$_z$ orbitals unchanged:

![Diagram of sp hybrid orbitals]

construction of sp hybrid atomic orbitals by mixing 2s and 2p orbitals

Again directionality is conserved, the linear sp orbital array reflecting the one-dimensional character of the starting p orbital. When two of these sp/sp/p/p orbital arrays from carbon are assembled with two 1s orbitals from hydrogen, the result is
overlap to form two C—H σ bonds and a C—C \emph{triple} bond, composed of a \( \sigma \) bond and two orthogonal \( \pi \) bonds:

\[
\begin{align*}
\text{H} & \quad \pi_y & \quad \pi_z \\
2p_y & \quad sp & \quad sp \\
2p_z & \quad H 1s
\end{align*}
\]

\[
\begin{align*}
\sigma \quad \sigma \quad \sigma \\
C & \quad C & \quad H
\end{align*}
\]

\( \sigma/\pi \) bonding scheme for acetylene

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