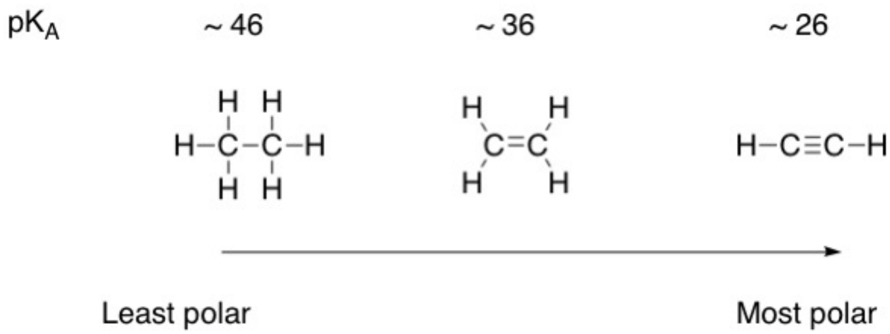
REVIEW

Characteristics of Alkanes, alkenes, and alkynes

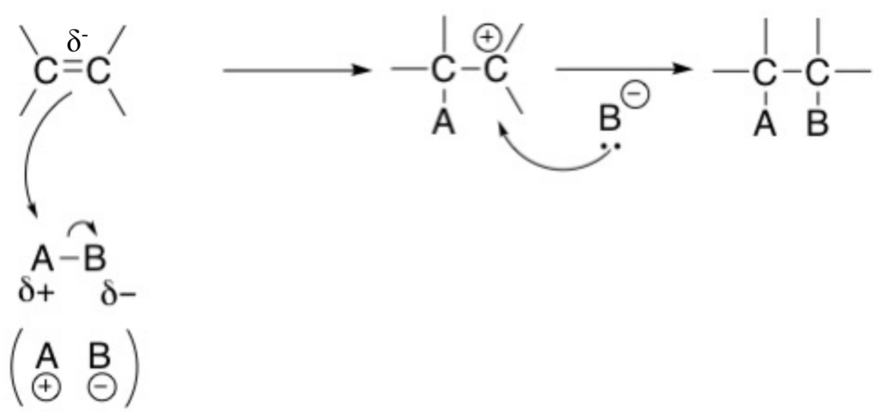



Alkynes have higher boiling point, melting point, and density

**Addition Reaction:**

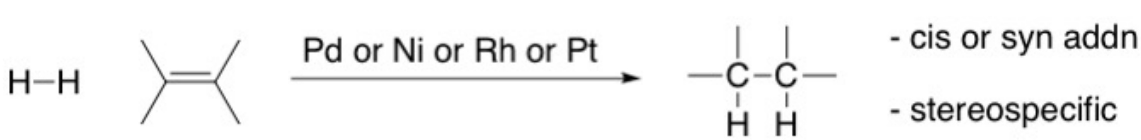
- Large amount of negative charge concentrated on the π-bond ($\delta^-$). An **electrophile**, a species that seeks negative charge (electron-loving), would then get attacked by the electrons in the π-bond, hence forming a new bond.

**General Mechanism**

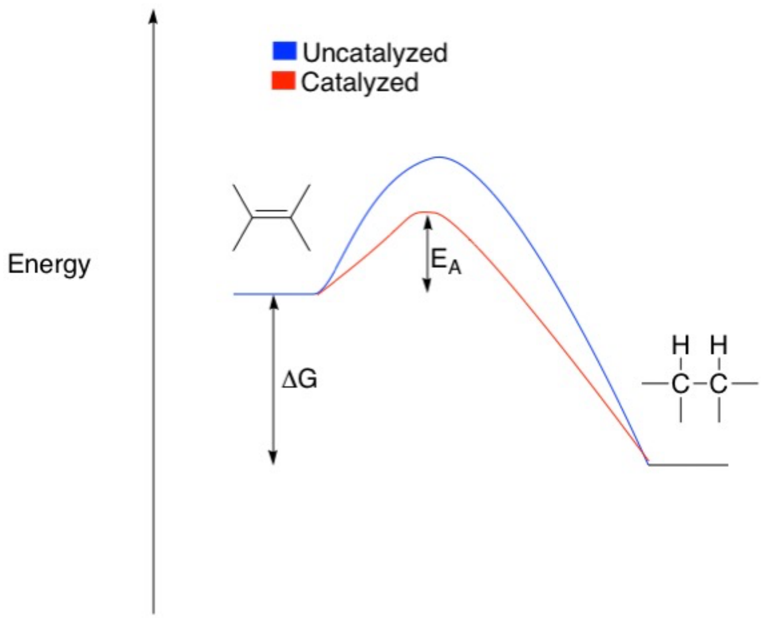


A is an electrophile – seeks electrons
B is a nucleophile – seeks nucleus
Alkene = olefin

**Hydrogenation Addition of $H_2$**

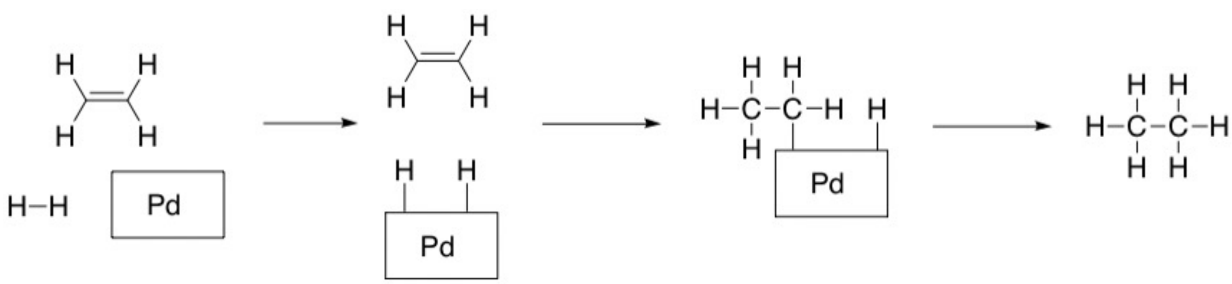


This reaction is **stereospecific**, meaning that the stereochemistry of the starting material determines the stereochemistry of the product (in this reaction, cis). Needs a catalyst for the reaction to proceed. The metals palladium (Pd), nickel (Ni), rhodium (Rh), and platinum (Pt) act as catalysts to facilitate this reaction.



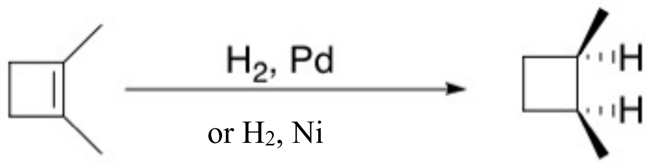

**Catalysts** accelerate the reaction rate by providing a lower energy pathway (red curve above). In general, they are not permanently converted to other products

**Mechanism of hydrogenation**



**Hydrogenation examples**

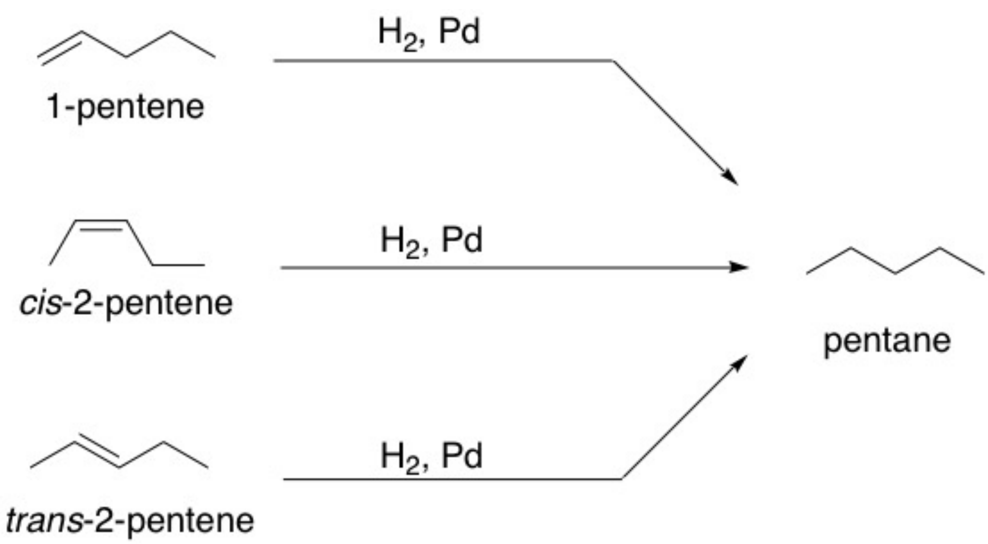
**Example 1**: 1,2-dimethylcyclobutene




1,2-dimethylcyclobutene *cis*-1,2-dimethylcyclobutane

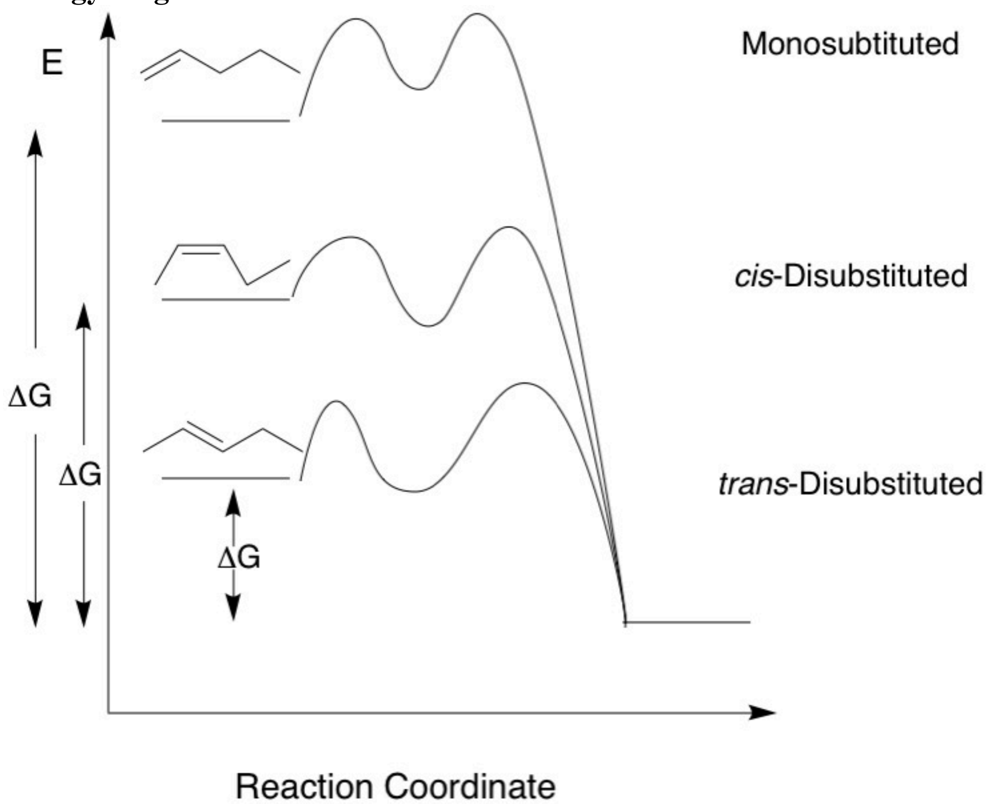
The hydrogenation can occur from the top or the bottom, which in this case produces the same product (cis isomer of 1,2-dimethylcyclobutane).

**Example 2:** Pentene



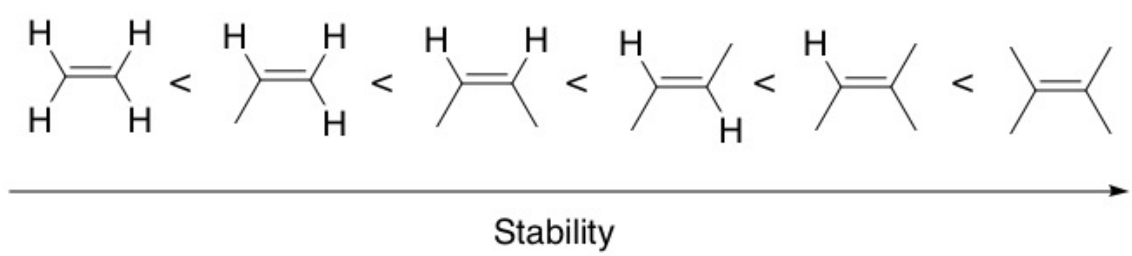

Energy is released in each of these reactions, the energy released implies stabilization caused from transforming the starting material into the product.

**Energy diagram**



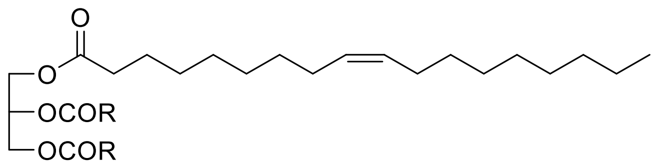

ΔG *trans*-isomer < ΔG *cis*-isomer < ΔG 1-pentene isomer

Alkenes with more substituents are more stable. Carbons in a double bond have a δ+ (electron-deficient), this is stabilized by the **electron donating effects** of alkyl groups. Hydrogens are less electron donating and so less substituted alkenes are less stable. Cis alkenes are less stable than trans alkenes as they have methyl groups facing the same direction which causes unfavorable steric interactions.

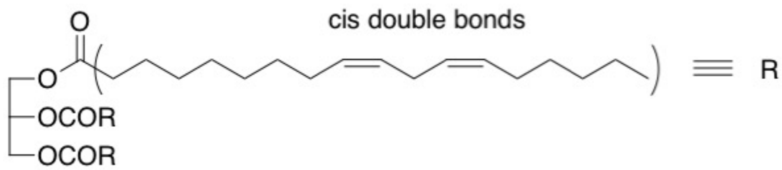


**Example 3:** Fats

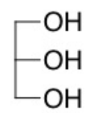
**Fat**



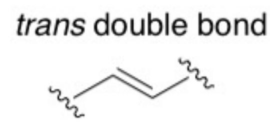
**Monounsaturated triglyceride**



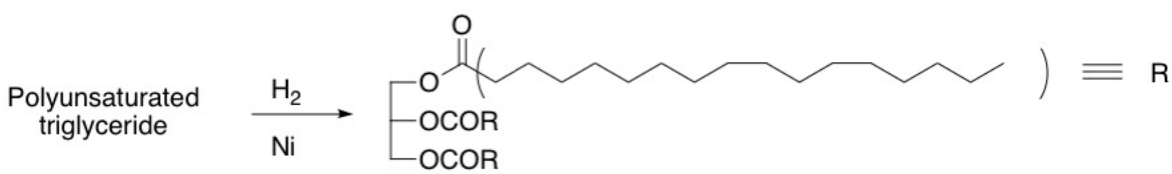

A triglyceride



Glycerol

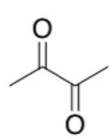



- The triglyceride is a triester of glycerol
- It is a polyunsaturated (>1 double bond) fats (e.g. canola oil)- unsaturation refers to the double bonds.
- Trans double bonds can also be generated in fats, which are then called trans fats.
- Hydrogenation give saturated fats (**unsaturation removed**)




Major component of margerine

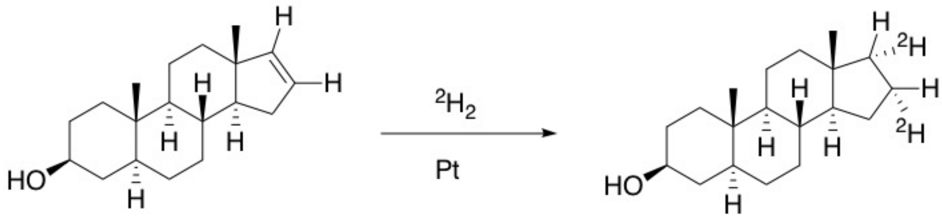
A solid saturated fat (margarine)
This molecule has greater London dispersion forces, cause it to exist as a solid



Diacetyl

Butter flavoring that adds a yellow color

**Example 4**: Steroid

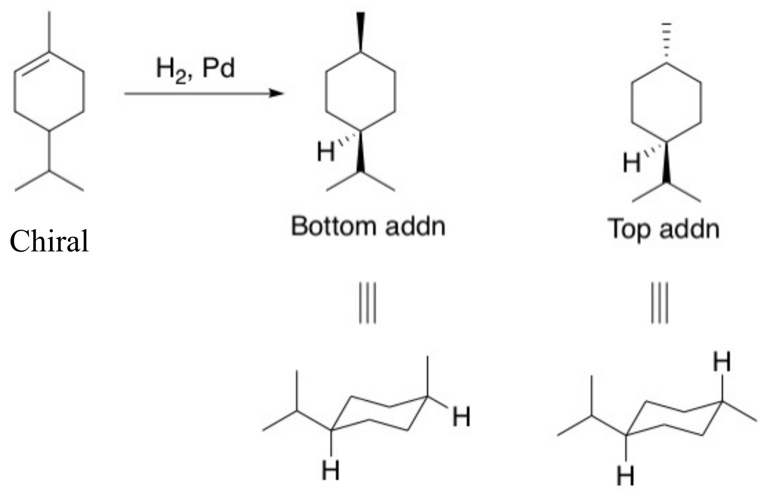



The deuteriums add to the back because of the steric hindrance of the nearby methyl group.

$^2H$ = D = deuterium

**Example 5:** Limonene

Limonene




The two possible products are diastereomers and are achiral (plane of symmetry).